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# JOURNAL

OF THE

# UNITED STATES ARTILLERY

PUBLISHED UNDER DIRECTION OF THE

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## VOLUME XIX

1903.

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MANAGER AND EDITOR.

Captain ANDREW HERO, JR., Artillery Corps.

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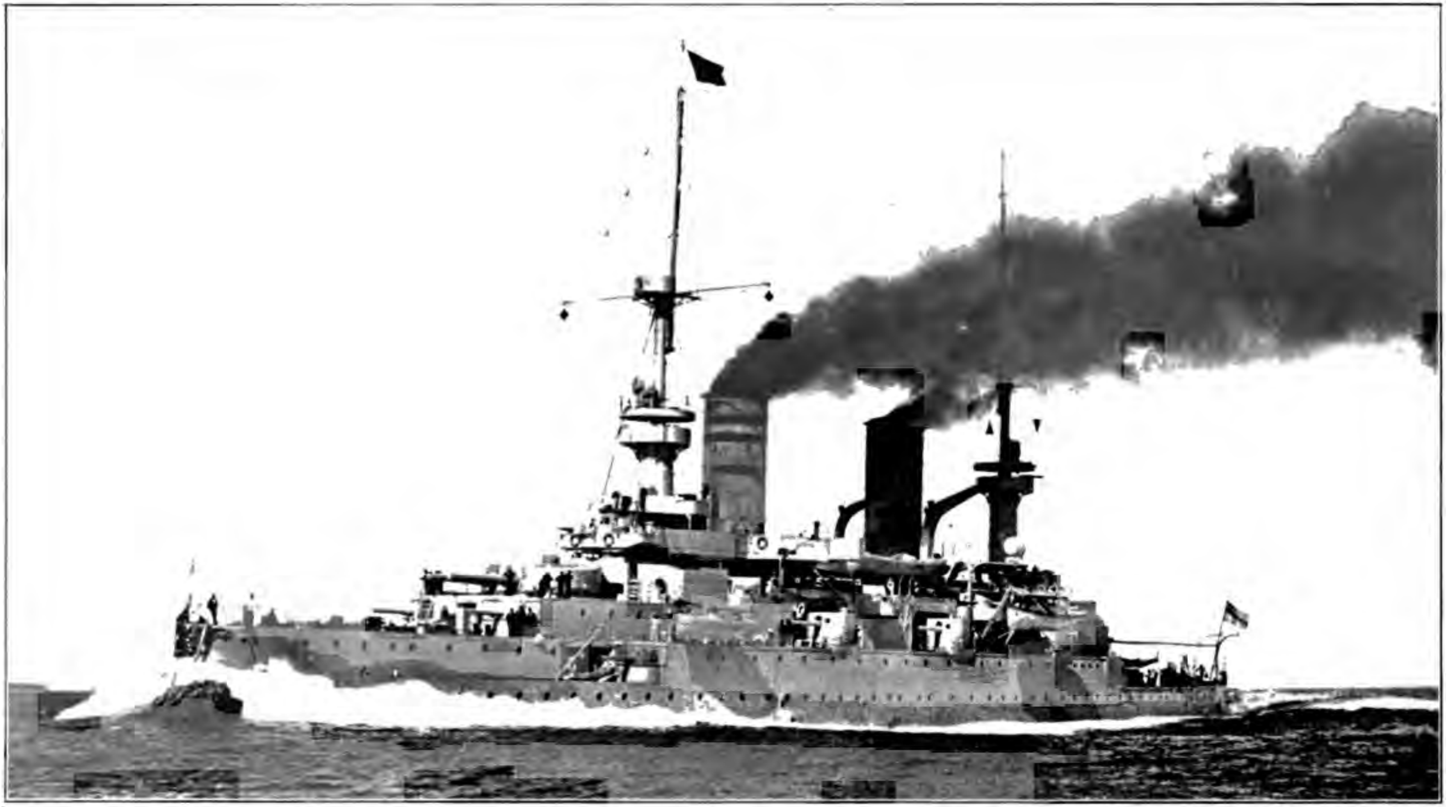

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CAMBRIDGE, MASS.

# A STEP FORWARD.

The first type 8-inch B. L. rifle of our land service was tested by the Ordnance Department in 1888. All of the large calibre rifles now mounted in our coast defense forts have been designed, manufactured and mounted since that year. In the early nineties, the Engineer Corps was at work on the emplacements and the Ordnance Department on the guns and mounts. Later the two parts of the system were brought together, and the work of installation was commenced; but it was not until about 1895 that this modern material began to be turned over to the artillery. The greater part of the armament has been installed since 1897.

The artillery at that time was handicapped in readily adapting itself to conditions that imposed a system wholly new to the service. Its organization was in no way suited to united, prompt and systematic work. The Chief of Engineers and the Chief of Ordnance are reported to have said that one of the principal difficulties of the situation was that it was impossible to find out exactly what the artillery wanted, and to obtain any coördinated action from that arm of the service.

After the emplacements had been made and the armament installed, it was necessary to develop a complete system of regulations for the care, maintenance and effective use of these shore defenses. The regimental organization then existing was unsuited to the requirements thus presented. What could a number of independent colonels in command of regiments with no control over companies not serving at headquarters, do in the direction of united action along the lines indicated? It is true all who could, did what was possible to meet the new obligations. The organization was defective. The regiment had its origin with field troops, and while an essential unit on the line of battle, as a part of a brigade, it has no place as a natural unit for fighting or administration in connection with coast defense troops.

The principle in coast defense is that the fighting unit must be adjusted to, and vary with, the material found necessary for the defense of any particular locality. Moreover some head, who should be expert in technical artillery, was needed to co-ordinate the work and present to superior authority the artillery point of view.

It was realized by the War Department that the difficulties lay rather in the faulty organization of the artillery than in the lack of professional zeal or interest of its officers. Finally the Secretary of War became convinced that a re-organization of the artillery on a corps basis was necessary. His recommendations were eventually enacted into law in the Act approved February 2, 1901, and thus the first positive step was taken toward a satisfactory solution of the artillery problem. The very breath of life was breathed into the body of the artillery by that Act.

The new distinguishing features are the following :

"*Section 3.*—That the regimental organization of the artillery arm of the United States Army is hereby discontinued, and that arm is constituted and designated as the Artillery Corps."

* * * * *

"*Section 6.*—That the Artillery Corps shall consist of a Chief of Artillery.............................................."

* * * * *

"*Section 7.*—That the enlisted strength of any company may be fixed under the direction of the Secretary of War, according to the requirements of the service to which it may be assigned."

* * * * *

The effects of these provisions are :

1. To adapt the organization of the personnel of the coast artillery to the requirements of a correct system of defense.

2. To give the artillery a Chief who can speak with authority on all artillery questions, enabling the War Department to ascertain at any time what is most desirable from the gun-users' point of view.

3. Through the recommendations of the Chief of Artillery, to secure uniformity of methods and practice.

4. Section 7 introduces the feature of elasticity of company organization which is far-reaching in its adaptability and economy.

For the first time, the "company" of coast artillery becomes a variable unit. Its size may be varied to suit "the requirements of the service to which it may be assigned". Hereafter there is no reason, except the want of adequate troops, for a misfit between the manning body and the material which it mans. The number of men assigned to fight a particular fort may be determined by a scientific analysis of the requirements of the fort. Just as the crews of battleships must vary from ship to ship so must the manning bodies of our batteries, fire commands, forts and artillery districts vary with the armament, position-finders, search lights, power plants and lines of communications, which form essential parts of the material of modern coast works.

The Act of February 2, 1901, establishing an Artillery Corps with a Chief of Artillery and an elastic company, has brushed aside the main defects of organization, and the coast artillery is now in position to fulfill its obligations in a manner more satisfactory to itself.

The corps organization is to be preferred to the regimental organization both on the ground of efficiency and economy. It receives the hearty approval of almost all officers of the arm, especially those who have given study to the subject of organization and have noted the operation of the corps system during the past two years. But another point also merits attention. Formerly with the regimental organization, it was the policy to transfer regiments as a whole from one part of the country to another. Now it is no longer necessary to shift companies in this way. Under the old system, too, where a regiment was ordered to what was considered undesirable stations, it often happened that officers thereof, by influence or otherwise, succeeded in getting detached from their companies or regiments, in some cases during the whole tour of the regiment at those stations. Now, with respect to the transfers of officers and their detachment from their commands, the changes made are precisely adjusted to the needs of the service and are fewer in number than ever before. It is also known that at present a roster of service of each artillery officer is kept in the office of the Chief of Artillery, and it can be shown from these records that there has been a more equitable distribution of service at desirable and undesirable posts than ever before in the history of the artillery.

Section 6 of the Act creates the office of a Chief of Artillery, which has been long and greatly desired by earnest advocates of a proper artillery organization, and thus gives the artillery corps its definite official head. This gain is of inestimable value to the artillery.

With headquarters in Washington, in close touch with the heads of the various War Department bureaux on which the artillery depends for its material, member of the Board of Ordnance and Fortifications, and at the same time thoroughly conversant with all matters pertaining to the artillery, its efficiency, needs, instruction and training, he not only is the adviser of superior authority on all artillery questions, but also is in position to regulate and co-ordinate all artillery plans and methods, to introduce uniformity into systems of defense, and, by recommendation and suggestion, can do much towards securing a thoroughly trained and efficient artillery force. The recommendations, coming from this office, that have been adopted, and the results that have been obtained in the past two years amply justify these statements.

It may be well to examine more closely some of the benefits that have accrued from this new organization.

Of all the class of changes in regard to tactical fighting efficiency, the creation and organization of the artillery district is no doubt the most important. The Chief of Artillery recognized this, and one of his earliest recommendations was the proper organization of our seacoast into tactical units termed districts. The artillery district consists of a group of forts. The especial duties of the artillery district commander are to look after the equipment, artillery supplies and general fighting efficiency of all the forts in his district. The general discipline and fire discipline of the entire artillery district is kept up to a high standard by frequent inspection of the material to the smallest detail possible, and by frequent tests of the manning bodies of the several fire commands and forts in simulated action and actual target practice and fire control. The artillery district commander has charge of all matters relating to the completeness of the equipment and the efficiency of the personnel, and by these frequent inspections the actual work of the troops may be determined and compared. The effect of this has been to excite generous rivalry among the forts and to increase the smartness and drill efficiency along the whole line.

A complete system for fire control and fire direction of great promise has been installed at Fort Barrancas, Florida, which is soon to be tested and if successful will entirely alter the existing systems in our service. The initiative in this test was taken by the present Chief of Artillery.

The matter of technical education has received the close study and earnest support of the Chief of Artillery. As soon as the position of Chief of Artillery was created its influence for good was felt in the Artillery School. Among other things, a new and much needed modern equipment for the Department of Electricity, Mines and Mechanism was obtained solely through his efforts. The School of Submarine Defense may be said to have been founded by him, and the same guiding hand has directed the artillery features of the Field Artillery School at Fort Riley.

One of the essential needs of the coast artillery service is that of qualified men to maintain and operate the scientific instruments and other appliances pertaining to fire control and direction. To supply this want, and for the further instruction of our gunners, a school of gunnery specialists has been established, upon the recommendation of the Chief of Artillery, at Fort Monroe, where certain eligible gunners are sent from the artillery districts for training in technical artillery science.

In close relation to the service artillery schools stands the matter of examination for promotion. Upon the recommendation of the Chief of Artillery, a new scheme for examination of artillery officers has been proposed, and with its promulgation a new standard will go into effect, a standard higher in its technical requirements than ever before attempted in the United States. No other service, it is believed, at present strives for so broad and practical a course in its coast artillery.

Along this same line of keen perception of the technical requirements of the coast artillery may be mentioned the combined army and navy maneuvers of last September, which originated in the office of and were first recommended by the Chief of Artillery to the Secretary of War. While the maneuvers accomplished good in all directions, they did more for the coast artillery than for other branches,—more than can be now estimated or expressed. The Spanish war had not tested in any adequate way or by direct attack any of our coast defenses. It required such a test as the navy gave them to develop engineering, ordnance and artillery deficiencies. Not the least important benefit derived from these maneuvers was the demonstration of the need of further maneuvers of similar nature; and so valuable did they prove that plans are already being prepared for like evolutions in 1903, in which other artillery districts may be mobilized and the personnel and material tested under conditions approaching as closely as possible those of actual war.

In the field artillery, the establishment of a field artillery battalion, by which means two or more batteries of field artillery are placed in friendly rivalry, and training is afforded for officers of field rank in the artillery arm, may be mentioned as one of the advantages that has resulted from recommendations made by the Chief of Artillery. Heretofore, when armies have taken the field in time of war, there has never been any officer of artillery who was thoroughly fitted for appointment as Chief of Artillery on the staff of the Commanding General in the field. The commanding officer of these field batteries would be qualified by experience for such position, and, consequently, be in line for promotion.

It is a fundamental principle of organization that rank should always be commensurate with the responsibility involved. It seems hardly necessary to mention the fact that the "Chiefs" of Ordnance, Engineers, Signal Corps, Record and Pension Office, all hold the grade of brigadier-general. It may be observed, too, that the Commandant of the Marine Corps has the rank of major-general. It seems a matter of simple justice and propriety that the Chief of Artillery, responsible as he is for the efficiency not only of the entire coast artillery but also for the field artillery, numbering 17,742 men, should have the rank of brigadier-general while occupying that position.

Finally, it may be stated that any impartial observer of the accomplishments of the past two years must admit that thanks to the special features of the Act of February 2, 1901, establishing an Artillery Corps and creating a Chief of Artillery, the arm as a whole has been able to take a good step forward.

# COAST ARTILLERY ORGANIZATION.

By Captain FRANK W. COE, Artillery Corps.

It is an oft repeated axiom that the business of a soldier is war. It may be that he looks forward to war with more dread than his civilian brother, because he sees its horrors more clearly, but that does not make it less his business. Professionally war should be forever in the foreground of his mind. In target practice and maneuvers he finds a pleasant and profitable recreation, but let him not forget that it is not war. In target practice the target is simulated—in war it is different; in maneuvers the personnel and material of a command are readily fitted out to completeness, at the expense of a command not in the maneuver district—in war it is different. Then is material telegraphed for in vain; then is raw personnel to be had instead of trained troops; then is hurry, bustle and confusion, in spite of all the repetitions of "in time of peace prepare for war". It behooves the artillery to demand, and to force its demand into public notice, such equipment and such an organization as will enable it to pass through this nightmare of war preparation in the smallest possible time, and to emerge from it awake and ready for whatever may come. As regards material, we must sit up nights until we know just what we want and until we get that want supplied. As regards personnel, we must be able to get and maintain the highest rate of fire and the most accurately delivered fire of which the gun and mount are capable.

It is to the personnel of the coast artillery that I would draw your attention and under the following heads:

1. The present organization.
2. A perfect personnel and its essential constituents.
3. The proper peace organization.

### I. THE PRESENT ORGANIZATION.

The conditions which led to the present organization of the coast artillery are familiar to its officers. The old regiment was found to be a drag upon the work which was to be done and it was accordingly dropped. The dispersed companies were then united into a corps, of which we may have reason to be proud, and the new organization began to fight its onward way. The step was undoubtedly a wise one, for regiments, however much as a matter of sentiment we may regret their dispersion, have no place in the coast artillery; but the reorganization except in a purely numerical way did not affect the company—*the fighting unit of the artillery*. The results attained were an increase of facility in the transaction of paper work and the unification of forces working towards a common end. The former is too often regarded as the object of organization. It is a result to be aimed at but it is not *the object* of organization, which should be, first and always, the attainment of a maximum efficiency in war. Let the red tape take care of itself; allow enough, and it will work out its own destruction.

Let us see why each company of artillery has come to consist of a certain number of sergeants, corporals, musicians, cooks, etc. Simply because each company of infantry has a certain number of sergeants, corporals, cooks, etc. The fact that the numbers may be different in the two branches has nothing to do with the reason of the answer. Now a company of infantry has this number of men in different capacities because it is thought that under such circumstances it will be most efficient when on the firing line in actual combat. This is the whole reason for company organization as it is, and this reason is not a good one in the case of the coast artillery. The company of artillery is a convenient administrative unit and that is all; *convenience of administration* is secured at the expense of *fighting efficiency*. Moreover if artillery companies varied in strength between 50 and 300, their administration could be as *efficiently* and *economically* carried on, with perhaps a little more trouble than at present, and at the same time we might attain properly organized commands for real fighting purposes. For let us look into just what strained and abnormal positions our 109 man-unit must be placed. A mortar battery of sixteen 12-inch mortars requires for the service of the pieces 288 men. A battery of two 12-inch rifles requires for the service of the pieces 54 men. (Leave special details out of consideration for the present.) Suppose a post with the above armament, garrisoned with two, three, or four companies. One company assigned to the battery of rifles gives two reliefs. The remaining companies, one, two or three as the case may be, assigned to the mortar battery gives, at best, a trifle more than one relief. In the case of three companies they must be divided among four mortar pits, all just alike, which means, to obtain *results*, the disorganization of the three companies and their reorganization into a single fighting unit made up of four subunits. So much for the enlisted strength. Take the officers in the case of a four company garrison at the supposed post; at the rifles are three, at the mortars, nine; not a bad division of the officers, but do not fail to note that the probable peace garrison of this post would be two companies, not four.

The above is a single illustration of the difficulties into which our organization puts us; every seacoast fort furnishes another. I fear, however, that I have not put the case strongly enough before you, so that the absurdities of the situation stand out with sufficient clearness. Let me make a comparison.

Suppose a man owns one hundred hotels, distributed all over the country, if you please—in New York, Boston, Baltimore and smaller towns and villages. For their service he employs ten thousand servants, an average of one hundred for each hotel; but some of the hotels require to run them four hundred servants and others but twenty. In each, of course, there are stewards, clerks, cooks, bell-boys, etc., all of whom must be paid, clothed and fed. To accomplish these ends, or to accomplish anything else, would it ever occur to the proprietor to divide the force of ten thousand servants up into squads of say one hundred; and in each squad to appoint a certain number of them stewards, and a certain number clerks, and a certain number cooks, and so on? I am well aware that comparisons are often worthless, especially if carried too far; but they may sometimes help us to open our eyes to the other side of a question.

It may, perhaps, be said that if it should ever come to a question of the manning of our guns for actual service, the men would be assigned to the different emplacements in the proper proportion. Now that is just what would produce chaos; just what would cause disaster. The very object of organization would be defeated. It would be the taking apart of the military machine when the machine was most necessary to the safety of the country. The one aim of a soldier, of infantry, cavalry, or artillery, should be a maximum efficiency of his command *on the firing line.* *Discipline* is the first requisite—the force that makes the machine move. *Organization* is the second—the gathering together and proper placing of the small component parts which make the machine. *Training* is the third—the careful polishing of the bearings, the cutting away of a cog-wheel here and the insertion of a more perfect part there. To tear apart the construction and start upon a new invention at the outbreak of war would be insanity.

There is another point. The Nation demands of its army protection from minor annoyances at all times, but it does not demand that its small army shall meet, unaided, the greater perils that may threaten from time to time. At those times the people themselves will join in the defense, and it is the duty of the army to be ready to take them and make use of them, to make them a part of itself. It is with the ability of the *artillery* to do this that we are concerned. How is it to be accomplished? Is a new machine to be built from the ground up or is the raw material to be used as a fly-wheel to make complete the carefully constructed parts of the machine already on hand? It is certain that our present organization is not calculated to obtain the desired result in either way.

## II. PERFECT ORGANIZATION AND ITS ESSENTIAL CONSTITUENTS.

In order to determine a rational coast artillery organization, let us analyze a perfectly organized, trained and equipped seacoast fort, and seek to determine of what the personnel essentially consists.

The first thing to be determined in this analysis is the total number of the personnel. This number must be the minimum consistent with our hypothesis of perfection. More than this number would not be economy and therefore not perfection.

Of course it would be *ideal* to have three complete and permanent reliefs at every emplacement, nor can it be denied that there is an abundance of high authority for the statement that three reliefs are *necessary*; but in what does this necessity consist? The question must be discussed almost entirely from a theoretical standpoint. History furnishes no instance of importance to be used as a basis for any conclusions in considering the struggle between a modern seacoast fort and a modern battleship. That the old fashioned fights, lasting through a day or a night, are of the past is certain. The action of the future will generally be brought on by an attempt on the part of the ships to run past the forts. Its duration will be a question of minutes, not as long perhaps as the ordinary drill hour, and except for the quick-firers there will be no need for reliefs—they will not even be thought of.

But we must also consider the possibility—not a very probable possibility to my mind, but one that is by no means certain not to arise—of a bombardment preliminary, if not disastrous to the fleet, to other operations. Take a fort mounting sixteen mortars and two 12-inch disappearing rifles, certainly a minimum for the defense of a channel of any importance. Assume a fleet of ten battleships bombarding for one hour. In that hour 480 mortar shells will have been fired from the mortar battery. If one shot in twenty finds the proper target, each vessel will have been struck 2.8 times. One hundred and twenty projectiles will have been fired from the 12-inch battery. If one shot in five, hits, each vessel will have been hulled 2.4 times. The engagement will hardly outlast that hour and the second relief will find little to do. I think there will be no opposition to the statement that in the case of large calibre guns, one gun detachment can serve the guns throughout any action which we shall ever see. (Vacancies due to casualties are of course to be filled from the reserve, which will be considered presently.)

There is another point of view however which must not be overlooked. Assume the shore defenses to be supplied with the necessary patrol and scout boats, so stationed as to obtain the full benefit of the search lights, and to prevent, absolutely, anything in the nature of a surprise. Even with such auxiliaries to start with, conditions may arise which will strongly *tend* to keep the men at the guns night and day for an indefinite period. For example, a crippled or unprepared fleet of our own may be within the harbor, blockaded by a strong hostile fleet outside. Secrecy regarding his position is no longer an object with the enemy, nevertheless his intended movements are known only to himself. He stands just outside of the range of the most powerful guns ashore. Each night, perhaps a dozen times each night, he starts towards the harbor entrance, only to turn back as soon as the gunners are awake and at their posts. It is an exasperating situation and one in which two or three reliefs would be exceedingly welcome to everybody ashore—but, is more than one relief necessary? Can one relief do the work—do it well—do it without too great a strain—the work which three could do with comfort?

This question is of vital importance for two reasons. In the first place on account of the question itself—the answer determines for what the artillery must strive as regards the *number of its personnel.* In the second place, the conditions assumed are those under which, in all probability, the first real test of fort against ship will be conducted.

The question must be answered in the affirmative; at the same time certain conditions must be imposed. The one relief must have shelter and be provided with food *at the guns.* Each man must sleep just as near his proper post as possible. When the call to arms is sounded it is the signal to *open fire* and every gun which has the requisite range should be fired within two minutes of the sounding of the alarm. To this end the guns should of course be kept loaded all of the time (mortars with projectiles only).

The fire commander and the battery commanders must be kept continually aware of the exact location of the fleet and of its every movement. The instant a vessel is within range, the alarm is sounded—but not before. For one minute the vessel is tracked—thirty seconds more and the data are at the guns. During this time the men have taken their posts and are ready to lay the guns as soon as the necessary information reaches them.

The conditions assumed are those of a clear night or even of the daytime. In case of a fog or of a rainy night, it must be remembered that *the enemy cannot be fired on before he is seen.* The one and one-half minutes in which to man the works still remain to the gun detachments.

In order to accomplish all of this, our fire control system needs careful attention and systematization throughout the service. Every attempt to attain good results will be futile unless the *communications* are given especial care. A fire commander can not stand ringing a telephone bell for ten minutes in order to get into touch with a battery commander, finally, perhaps, to have his message incorrectly transmitted after all. Rapid and accurate communication is a vital necessity of fire control as well as of fire direction, and if I were called upon to say just what men in the artillery needed the most training at present, I should say the telephone men.

The question as to the necessity of more than one relief was given a practical answer, within certain limits, during the past summer, when many emplacements were manned throughout the maneuvers with a single relief. To be sure the period of hostilities was only six days, but, with certain increased protection for cold weather, the state of preparedness for action which was kept up during those six days could have been maintained indefinitely.

We might also go back to the war with Spain to further illustrate the sufficiency of one relief at the guns, but the conditions were then very different from now, and conclusions based upon that period alone would be unsatisfactory. The artillery was then in a transition stage, and it was generally not a question of manning the guns but of mounting them. The recent maneuvers of six days were of more real value in teaching the artillery what it needs, what it has that is useless, and what it can and can not do, than were the three months of actual war.

Let it be understood that we have been considering so far, the men at the guns only. There is no question that at certain points in our system of fire control, if not for the whole system, reliefs are necessary. This is particularly true in the case of certain officers, as for example the range officer in a battery commander's station well to the front of the line of defense. His duties are almost continuous and perhaps even more trying in maneuvers than in war. They certainly increase in inverse ratio with the size of the maneuver district and it is to be hoped, though not for this reason alone, that the size of the maneuver district may be increased from year to year, until it finally comprises the entire coast line of the country.

The next matter to consider is the question of casualties and of the proper reserve It is one which to settle definitely would require a minute inquiry into details, but to make a broad classification, we may put mortars and disappearing guns in a class requiring a small reserve. Barbette guns of large calibre require a medium reserve, and rapid-fire guns a reserve amounting to two or even three reliefs. In advocating a small reserve for barbette guns, I do not wish to be classed among those who claim for the heavy artillery immunity from all danger. When the time does come, to stand up before the murderous hail of broadside upon broadside from a modern battleship, there will be an abundance of people getting hurt; and I confess to a dread of the effect upon the morale of the men at the guns; but, taking the detachment as a whole, the proportion which is completely protected is large compared to that which is exposed, and consequently the necessary reserve is small.

With the guns manned and with a proper reserve there remain to be considered in an ideal fort ready for action, the auxiliaries, consisting of electrician sergeants, observer sergeants, range finding details and search light details. This auxiliary personnel is of vital importance to the fighting efficiency of the fort, and it is the unanimous opinion of all artillerymen that they should be highly trained men *permanently occupying their positions.* The need of at least two reliefs has been already referred to. With reference to the observer sergeants, I cannot pass them over without remarking upon the necessity of keeping in the service by proper pay a man who has shown the qualities necessary to efficiently fill the position. We find men in the companies able to do the work, we train them, and we lose them. To keep them, their pay must be made commensurate with their importance and their duties.

The personnel which we have been considering we assumed, at the outset, to be perfection. As regards that part which is at the guns, it may be divided into two parts :

1. A part, the duties of which require of the men extensive training before they can be performed to perfection.

2. A part, the duties of which are essentially the application of physical force, either directly or through the agency of machinery so simple as to require a comparatively small amount of training for its use.

To illustrate, let us take a 12-inch B.L. mortar, the detachment for which consists of eighteen men.

To the first class belong:

The gun commander, duty, general supervision and laying in elevation. The gunner, general supervision and laying in azimuth.

Numbers 1 and 2, manipulation and care of the breech, seating primer, etc. Number 5, giving elevation under direction of gun commander. Number 7, bringing powder charge and giving azimuth under direction of the gunner.

Ammunition sergeant, in charge of magazine and shot room.

One member of ammunition detail, fuzing projectiles.

One member of the ammunition detail, at the shot hoist.

To the second class belong the remainder of the detachment. What is essentially required of them is plain hard work. This work might be done, partially at least, by machinery, but the policy seems to be, and I doubt not its wisdom, to avoid unnecessary machinery, using instead the more certain and generally as expeditious methods by hand.

The training required of the second class is simple for the most part, but it is *necessary*. I do not hesitate to say that it might invariably be acquired in one month—but in case of need that month is a month of war—a month in which a lack of preparedness on the part of our coast forts may be productive of disasters which must be retrieved at a cost of years of struggling and millions of money. Is the Nation willing to take the risk of paying this price? Or will it pay for insurance against such a catastrophe a few of the dollars which it so generously hands out for other worthy purposes? It is not for the artillery to answer; but the responsibility of the artillery will be great if they have neglected to point out their own weaknesses and to demand a proper strength.

### III. PROPER PEACE ORGANIZATION.

I have attempted to show in just what a thoroughly efficient personnel consists, and if my deductions are not at fault the conclusions are obvious.

*For each battery of guns there is required a force, trained in time of peace into a smoothly working unit of personnel, and adapted to and fitting the material-unit to which it is assigned.*

The following table, based upon the minimum requirements which we have determined, gives this force for the different batteries of the service.

TABLE

| | Colonel. | Lieutenant-Colonel or Major. | Captain, Adjutant. | 1st Lieut. Ord. Officer. | Captain, F. C's Range Officer. | Captains. | 1st Lieutenants. | 2nd Lieutenants. | Observer Sergeants. | Electrician Sergeants. | First Sergeants. | Quartermaster Sergeants. | P. F. Detail (Two reliefs.) | | | Search Light Detail (Two reliefs.) | | | Gun Detachments (One relief.) | | | Mechanics. | Cooks. | Musicians. | Total. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | Sergeants. | Corporals. | Privates. | Sergeants. | Corporals. | Privates. | Sergeants. | Corporals. | Privates. | | | | Officers. | N. C. Officers. | Privates, etc. | Enlisted. |
| Artillery District. | 1 | | 1 | 1 | | | | | | | | | | | | | | | | | | | | | 3 | | | |
| Fire Command. | | 2 | | | 2 | | | | 2 | 2 | | | 4 | 8 | | 2 | 2 | 4 | | | | | | | 4 | 20 | 4 | 24 |
| 2-12″ B.L.R's | | | | | | 1 | 1 | 1 | 2 | | 1 | 1 | 4 | 8 | 20 | | 2 | 2 | 2 | 4 | 48 | 2 | 2 | 2 | 3 | 24 | 76 | 100 |
| 2-10″ B.L.R's | | | | | | 1 | 1 | 1 | 2 | | 1 | 1 | 4 | 8 | 20 | | 2 | 2 | 2 | 4 | 40 | 2 | 2 | 2 | 3 | 24 | 68 | 92 |
| 2-8″ B.L.R's | | | | | | 1 | 1 | 1 | 2 | | 1 | 1 | 4 | 8 | 20 | | 2 | 2 | 2 | 4 | 30 | 2 | 2 | 2 | 3 | 24 | 58 | 82 |
| 3-12″ B.L.R's | | | | | | 1 | 1 | 1 | 2 | | 1 | 1 | 4 | 8 | 20 | | 2 | 2 | 3 | 6 | 72 | 2 | 2 | 2 | 3 | 27 | 100 | 127 |
| 3-10″ B.L.R's | | | | | | 1 | 1 | 1 | 2 | | 1 | 1 | 4 | 8 | 20 | | 2 | 2 | 3 | 6 | 60 | 2 | 2 | 2 | 3 | 27 | 88 | 115 |
| 3-8″ B.L.R's | | | | | | 1 | 1 | 1 | 2 | | 1 | 1 | 4 | 8 | 20 | | 2 | 2 | 3 | 6 | 45 | 2 | 2 | 2 | 3 | 27 | 73 | 100 |
| 8-12″ B.L.M's | | | | | | 1 | 2 | 2 | 2 | | 1 | 1 | 4 | 8 | 20 | | 2 | 2 | 10 | 10 | 120 | 2 | 3 | 2 | 5 | 38 | 149 | 187 |
| 16-12″ B.L.M's | | | | | | 1 | 2 | 4 | 2 | | 1 | 1 | 4 | 8 | 20 | | 2 | 2 | 20 | 20 | 240 | 2 | 4 | 2 | 7 | 58 | 270 | 328 |
| 2 R. F. Guns 6″ or 4.″7 | | | | | | | 1 | | | | 1 | 1 | 1 | 1 | 2 | | 2 | 2 | *4 | *4 | *32 | 2 | 2 | 2 | 1 | 14 | 42 | 56 |
| 2 R. F. Guns 15-pdr. or 6-pdr. | | | | | | | | 1 | | | 1 | 1 | 1 | 1 | 2 | | 2 | 2 | *4 | *4 | *20 | 2 | 2 | 2 | 1 | 14 | 30 | 44 |

* Two reliefs.

The first column of the table is a list of the principal batteries (units of material) which are found in our service. The other columns give the officers and men required to man these batteries, in other words the different *companies* of coast artillery required. These companies vary in strength from 82 men to 328 men, but each is to fight a unit of the material—a unit in the sense that the fire each is to deliver is, almost invariably, directed upon a single target. The exception is where one gun of a battery has an arc of fire which the other guns have not, and, in the very last stages of an engagement, this gun is required to fire upon a target which the other guns cannot reach.

As a rule, however, the whole battery, guns and men, are to be regarded as a *unit*, a thing to be handled by the fire commander as he would handle one of several gatling guns in a street fight. The responsibilities which the commander of one these units shoulders is about the same whether it be a battery of two 8-inch guns manned by 82 men, or a battery of 16 mortars manned by 328 men. His duties and relations to the F. C. are about the same in all batteries other than R. F. batteries.

Of course there is considerable difference between handling 328 men and 82 men, but in the first case the captain has to assist him six lieutenants, and in the second case, two. I think no objection will be offered to the ability of a captain to handle the 328 men when they are *at the mortars*, but I can imagine objections being offered to such a large company for administrative purposes. At the same time I should greatly like to see and hear from a captain who will state definitely one administrative function which he feels unable to *properly* perform, with the assistance of the lieutenants given, for any company in the above table. Administration is of importance, of great importance; but the administrative *unit* is a mill-stone which has been hanging around our necks too long. Let administration find its proper place and be regarded as one of the means to an end, and not the end itself. Fighting efficiency is the end, and to it all things must tend. Personal units must *fit* material units or we shall lose efficiency. If each company must consist of so many men in order to clothe, feed and equip them, then let us build only batteries of guns which will fit the companies. But if primary considerations determine the number and calibre of the guns which make up a battery, then let us have companies which are of the proper strength, both in officers, non-commissioned officers, and privates, to man these batteries.

For all infantry drills and ceremonies, companies of such varying strength are of course unsuited. If for infantry functions it becomes necessary to have in a garrison a secondary organization, well and good. I do not believe any such measure would be found necessary, but if it were, it could be accomplished *far more easily* than can the present coast artillery companies be transformed into commands suited to artillery duties.

By the Act of Congress of February 2, 1901, the enlisted strength of any company of coast artillery may be fixed, under the direction of the Secretary of War, according to the requirements of the service to which it may be assigned. Executive action only, therefore, is needed to put the present strength of the artillery upon a more rational basis. But more than that is necessary to put the artillery upon a footing such that it can effectually safeguard those interests of the country which are entrusted to its care. The report of the Secretary of War for 1902 gives the following guns, mounted at the close of the fiscal year 1902. Eighty 12-inch, one hundred and twelve 10-inch, eighty-nine 8-inch, one hundred and eight rapid fire, and two hundred and ninety-seven mortars. Assuming that these guns are distributed among 20 districts, averaging three fire commands to the district, and that there are the same number of 3-gun and 2-gun batteries, the number of officers and men *required for one relief* is as follows: 20 colonels, 120 lieutenant-colonels and majors, 278 captains, 210 first lieutenants, 214 second lieutenants and 22,061 enlisted men.

The total strength of the coast artillery is thus determined by the number of guns which are mounted and is definite almost to a man. When a battery is ready to be turned over by the engineers, it should mean an increase in the artillery of the proper number of men and officers. It seems certain that, for the battleships which Congress has built, Congress will supply men and officers as they are needed. It seems that it should be equally certain that the battleship's counterpart ashore will not be neglected and left "out of action" at the supreme moment.

In the training during time of peace of Heavy Artillery State Troops lies the way to the formation of the proper reserve. It will probably never happen that an entire body of state troops will be qualified to fill positions requiring much training; but if we could call these troops into service for two weeks every year, letting them fill the positions which require but little training and thus developing in them a reserve for these less important positions; giving them at the same time the benefits of target practice; the results would, I believe, be surprisingly satisfactory. The Heavy Artillery State Troops which I have seen and heard of, are very much in earnest, and show an eagerness to learn and become efficient which is most encouraging; but I feel sure that it is an impossibility, with the little time which they can give to the work, for them to be able to furnish, by themselves, a complete organization properly trained and drilled for the service of any seacoast battery. They can, however, fill the posts requiring little training, thus allowing the regular soldiers in these positions to fill vacancies as they occur in the positions requiring extensive training.

In conclusion, let me call attention to a need which is I think generally recognized and yet for which no proper and adequate provision is made. I refer to the necessity of infantry garrisons for artillery posts at the outbreak of hostilities with a naval power.

In the first place the concentration of infantry at these posts should be prompt. War in the future, as in the past, will come without declaration—it will come with aggressive action—and if our seacoast is selected as the point of attack, it is certain that the sea front will not be involved alone. The attack will come from front and rear, and infantry will be at a premium in our forts.

In the second place an intimate knowledge of the topography of the near by country will be of great advantage to infantry located at a fort. It is a knowledge that will be needful, not to the commanding officer of the infantry alone, but to the company commanders, the squad commanders, and to the privates themselves. The problem of defense will approach closely that of a fortified land front and small details will be of even more importance than they would be were the two forces facing each other on land. Beaches where possible landings can be made must be watched, roads must be picketed, lines of communication patroled. These duties as well as the maintenance of the regular post guard fall naturally to the infantry, leaving the artillery untrammeled in its work of serving the stationary armament. The infantry companies of the National Guard of the seacoast states are well suited to be used for these purposes. They are as a rule near to the places where they would be needed, and by sending them to the coast for the maneuver seasons they would soon acquire valuable knowledge of the surrounding country and of their duties. Furthermore the regular infantry will be needed for other purposes at the outbreak of a war, and will not be available to give to the forts the security which they will require.

This subject is incomplete without a reference to the matter of torpedoes—are the gun detachments to lay them or are there to be regular torpedo companies? These are important questions which should receive the immediate attention of the coast artillery.

# FORMULA FOR DETERMINING THE DEVIATING EFFECT OF WIND.

By Major G. N. WHISTLER, Artillery Corps.

Ever since the publication of my first paper upon this subject, I have endeavoured to obtain a satisfactory solution of this problem. The chief obstacle in the way has been the impossibility of integrating the value of $F(T)$. Major Pratt, Artillery Corps, has lately suggested to me a method of determining the values of $F(T)$ empirically, which appears to me to be entirely satisfactory, and which has enabled me to offer the present solution of the problem.

It has long been known that the actual deviating effect of a side wind upon an *elongated* projectile was much greater than that which could be produced under the assumption that the effect of the wind was simply to blow the projectile sideways. It has generally been considered that the wind effect could be divided into two parts: The direct wind effect which moved the projectile laterally parallel to itself, and the indirect wind effect which carried the projectile in the same direction as the wind but due to the fact that there was an accumulation of particles of compressed air about the point of the projectile all of which impinged upon the point with the same velocity as the wind, resulting in turning the projectile about its center of inertia, and thus bringing into play a deviating component of the resistance of the air to the motion of translation along the trajectory. The extra deflection found in practice was supposed to be due to this indirect wind effect.

It is manifest that the accumulation of particles of air about the point brings the center of pressure of the wind in front of the center of inertia.

If now we consider the wind as a single force acting at the center of pressure, the only work that it can possibly do is to turn the projectile about its center of inertia. It cannot possibly move the projectile laterally parallel to itself. Therefore, in the case of an elongated projectile, the effect of the direct wind effect is nil. The entire deviation is due to what has been called the indirect wind effect, that is, the wind turns the projectile, and the deviating component of the resistance of the atmosphere produces the deviation.

The present formula is based upon this hypothesis. In order to determine a mathematical expression representing these conditions, we must first determine the angle through which the projectile will be turned by the wind, which will not be constant but will be $F(T)$. It is manifest that the effect of the deviating component of the resistance of the atmosphere will be to change the direction of the trajectory through this angle, and the resulting deviation will be proportional to the sine of the angle into some $F(T)$.

NOTATION USED.

$V =$ Muzzle velocity in f.s.

$U =$ Velocity of the wind in f.s.

$D =$ Deviation in yards for a deviating component of the wind of $U$ f.s. for any time of flight.

$D_{10} =$ Deviation in yards for a similar wind effect of 10 miles per hour.

$T =$ Time of flight in seconds.

$d =$ Diameter of the projectile in inches (calibre).

$M =$ A constant.

$\theta =$ The angle through which the projectile is turned by the wind during its first second of flight.

$C_3 = \frac{W}{d^3} =$ Cubical density of the projectile.

$A =$ A function of the area of the longitudinal cross section of the projectile. It is the length in calibres of a rectangle the width of which is $d$, and the area of which is equal to the area of the longitudinal cross section of the projectile. We may call this the equivalent rectangle.

For determining the value of $A$ for any projectile see Table I.

$F(T)$ Functions of the time of flight, to be computed empirically and tabulated in accordance with Major Pratt's method.

Coefficients.—Various coefficients $B$, $B'$, $B''$, $H$, $H'$, $H''$, etc., will be used during the discussion in passing from one equation to another, where it is only necessary to indicate the coefficients.

Discussion of $A$.—Let $L =$ length of the equivalent rectangle in inches. Then area of longitudinal cross section $= Ld$.

But $A = \frac{L}{d}$. Therefore area of cross section $= Ad^2$.

In this paper all dimension will be considered in multiples of the calibre.

The mass of the air impinging upon the projectile during unit time of flight will be proportional to the area of cross section, and so long as the projectile remains parallel to the line of fire we may write

$$\text{Mass} = B' A d^2.$$

At the end of the first second of flight when the angle with the line of fire is $\theta$, we have

$$\text{Mass} = B' A d^2 \cos \theta.$$

Let $L'$ = the distance from the center of pressure of the wind to the center of inertia. In terms of the calibre this may be written $bd$.

At the end of the first second of flight the lever arm of the wind force will be $bd \cos \theta$ and at the same instant, we will have

$$\text{Moment of wind force} = B\ A\ d^3 \cos^2 \theta\ U; \qquad \text{(w)}.$$

in which $B$ contains $b$.

The rotary force of the projectile due to the rifling tends to maintain the projectile parallel to itself in its flight, and offers great resistance to the turning effect of wind.

As shown by Colonel Ingalls, page 206, Artillery Circular N, the energy of rotation of the projectile at the muzzle is equal to

$$0.79\ \frac{WV^2}{2g}.$$

For the ranges that we use, the velocity of rotation may be considered constant. Under such hypothesis, the above expression will represent the energy of rotation during the entire trajectory for any ranges which we will use in practice.

At the end of the first second of flight we will have:

Component moment of rotating force perpendicular to line of fire = $H\ W\ V \sin \theta$; in which $H$ contains $g$ and other magnitudes not necessary to specify in this discussion.

Equating these two moments we have,

$$H\ W\ V \sin \theta = B\ A\ d^3\ U \cos^2 \theta \qquad \text{(a)}.$$

or

$$\frac{\tan \theta}{\cos \theta} = \frac{B\ A\ d^3\ U}{H\ W\ V} \qquad \text{(b)}.$$

As the value of $\theta$ for wind component of 50 miles per hour will not exceed one or two minutes, the cosine is practically unity and may be neglected. Then,

$$\tan \theta = \frac{B\ A\ d^3 U}{H\ W\ V} \qquad \text{(c)}.$$

If the wind force always acted at right angles to the axis of the projectile, it would turn the projectile through the same angle for each second of flight, and when the time is $T$ the angle would be $T\theta$. This condition does not exist, and the angle corresponding to any time of flight may be written $F'(T)\,\theta$.

Now the time of flight for the maximum ranges will never reach 30″ and $\theta$ will never exceed 2′, and $F'(T)$ will always be less than 30. The ratio between tan 60′ and 30 tan 2′ is 1.0001; we may, therefore, without material error write $F'(T)\tan\theta$ for $\tan(F'(T)\,\theta)$. It is more convenient to write this function in the form of a reciprocal, that is, $\frac{1}{F'(T)}$. Writing $\theta'$ for $\theta$ we then have,

$$\frac{\tan\theta'}{F'(T)} = \frac{B\,A\,d^3\,U}{H\,W\,V}; \quad \text{or } \tan\theta' = \frac{B\,A\,d^3\,U}{H\,W\,V}F'(T) \qquad (c').$$

in which $\theta'$ is the variable angle which the projectile assumes with the line of fire under the influence of the wind during its flight. When $T = 1$ $\theta' = \theta$.

Let $D$ = the total deviation during a range $R$ corresponding to a time $T$, the range being measured along the line of fire. Then it is manifest that we will have

$$\frac{dD}{dR} = \tan\theta'.$$

But $R$ is a function of time and we may write

$$\frac{dD}{d(F''(T))} = \tan\theta'.$$

Substituting the value of $\tan\theta'$ from (c′) we have

$$dD = \frac{B\,A\,d^3\,U}{H\,W\,V}\,F'(T)\,d(F''(T)).$$

If we could integrate this formula between the limits $T = 0$ and $T = 1$ we could readily determine the equation for $D$ in terms of $T$.

Remembering that when $T = 0$, $F'(T) = 0$, and when $T = 1$, $F'(T) = 1$ and that in integrating between the limits $(T = 0)$ and $(T = 1)$, $F'(T)$ will disappear, and the integral of $d(F''(T))$ will assume some such form as $H'\,F(T)$, we may write

$$D = H'\,\frac{B\,A\,d^3\,U}{H\,W\,V}\,F(T) \qquad (d).$$

In Eq. ($d$) make $\frac{H'B}{H} = M$ and $\frac{W}{d^3} = C_3$. Substituting these values we obtain the general formula for wind effect:

$$D = M\,\frac{A\,U}{C_3 V}\,F(T) \qquad (1).$$

$H'$ is a constant, but it is not certain whether $H$ and $B$ are or are not constants. Therefore $M$ may or may not be a constant.

Consider an imaginary projectile for which $A = 1$ and $C_3 = 1$, and assume that we have a gun from which this projectile can be fired and kept head-on with a velocity as low as 1 f.s.

Required the deviation in yards for such an imaginary projectile, when fired with a muzzle velocity of 1 f.s. in a wind the deviating component of which is 1 f.s. for a time of flight for which $F(T) = 1$.

Substituting these values in Eq. 1, we obtain

$$D = M.$$

$M$ is therefore the distance in yards that such imaginary projectile would be deviated under such conditions for a time of flight for which $F(T) = 1$.

This distance is ot course a constant, *therefore M is a constant and positive.* In order that the general formula should be absolutely correct, it should contain a factor which is a function of the shape of the head. For modern projectiles the difference would be so slight that this factor may be omitted.

It should also contain the factor $\frac{\delta}{\delta_1}$. In a range table or B.C. table, this factor is always taken at unity. If used, it would have to be applied during the practice. This is impracticable and only important at extreme ranges and for extraordinary atmospheric conditions. When necessary to use it, simply multiply $D$ by one plus or minus the percentage of variation of the weight of the atmosphere.

It is manifest that formula 1 will be of no use unless we can determine the value of the constant $M$, and the values of $F(T)$ in terms of $T$.

### MAJOR PRATT'S METHOD.

Consider $F(T) = T^x$, in which $x$ is a variable exponent to be determined empirically for the various values of $T$. Whatever may be the value of $x$, when $T = 1$ it is manifest the $F(T) = 1$. Therefore as $A$, $U$, $C_3$, $V$ are all known or may be determined, if we can determine empirically the value of $D$ for a one second time of flight for any gun and projectile, for any muzzle velocity, we can compute the value of $M$.

Having determined the value of $M$, if we can determine empirically the values of $D$ for the various values of $T$ for any gun and conditions we can compute the values of $F(T)$.

It is convenient to change the form of formula 1 by making $U = 14.6667$ f.s. $= 10$ miles per hour, and include this value in $M$.

Then Eq. 1 reduces to

$$D_{10} = M \frac{A}{C_8 V} F(T). \qquad (2).$$

In the drill regulations seacoast artillery, we find the following empirical formula:

$$D_{10} = \frac{T^2}{\left[3.3 + \frac{R}{10,000}\right]^2}.$$

This formula has given most excellent results for the 8-inch, 10-inch and 12-inch guns at high velocities. Experience at Fort Wadsworth has shown it to be specially accurate for the 12-inch B.L. rifle with an M. V. of 2250 f.s. at even extreme ranges. Major Pratt and myself have concluded to compute by this formula the deviation for each second of time of flight, for this gun and for this velocity, and to accept this as representing *the present empirical data as to the deviating effect of wind.*

With this empirical data, I have computed the value of $M$ and also the values of log. $F(T)$ for each second of time from 1″ to 25″. This will be sufficiently close for all practical purposes. The deviations for times of flight which include fractional parts of a second can be interpolated by differences. In fact, it will be sufficiently accurate to consider the deviations as equicrescent between the integral seconds.

*General Formula.*

$$D = M \frac{A\,U}{C_8 V} F(T).$$

Log. $M = 0.5422009$.

*Special Formula.*

$$D_{10} = M \frac{A}{C_8 V} F(T).$$

Log. $M = 1.7085323$.

*Working Formulas.*

For cast iron projectiles and A.P. shot. $L = 3.5$, $n = 2$.

6-inch B. L. R., $D_{10} = (2.3920304) \frac{F(T)}{V}$

8-inch B. L. R., $D_{10} = (2.28972 53) \frac{F(T)}{V}$

10-inch B.L.R., $D_{10} = (2.2979088) \frac{F(T)}{V}$

12-inch B.L.R., $D_{10} = (2.2951203) \frac{F(T)}{V}$

For A.P. Shell. $L = 4.0$, $n = 2$.

6-inch B. L. R., $D_{10} = (2.4797723)\dfrac{F(T)}{V}$

8-inch B. L. R., $D_{10} = (2.3774672)\dfrac{F(T)}{V}$

10-inch B.L.R., $D_{10} = (2.3856507)\dfrac{F(T)}{V}$

12-inch B.L.R., $D_{10} = (2.3828622)\dfrac{F(T)}{V}$

For 8-inch converted rifle. $L = 2.5$, $n = 1.5$

$$D_{10} = (2.3293446)\frac{F(T)}{V}$$

The numbers in brackets are are the logarithms of the coefficients.

### TO USE THE FORMULAS.

In using these tables and formulas compute the values of $D_{10}$ for each exact second. The values of $F(T)$ will be found in Table II. Then interpolate by means of differences for the times of flight corresponding to the ranges used.

A single value when the differences are not known may be computed with great accuracy as follows:

Required the value of $D_{10}$ for the 12-inch B.L. rifle M.V. 2250 f.s. for a range of 10,000 yards. The time of flight by the range table is 17.″86.

Computed for 17″.

Log. $F$ (17″) = 2.2591188
Log. coef. for gun = 2.2951203
4.5542391
Log. $V$ = 3.3521825
Log. $D_{10}$ = 1.2020566
$D_{10}$ for 17″ = 15.924 yds.

Computed for 18″.

Log. $F$ (18″) = 2.2998340
Log. coef. for gun = 2.2951203
4.5949543
Log. $V$ = 3.3521825
Log. $D_{10}$ = 1.2427718
$D_{10}$ for 18″ = 17.489 yds.
" " 17″ = 15.924 "
Dif. " 1″ = 1.555 "
" " 0.″86 = 1.337

$D_{10}$ for 17″ = 15.924 yds.
Dif. " 0.″86 = 1.337 "
$D_{10}$ " 17.″86 = 17.261 "
By range table 17.250 "
Error 0.011 "

### ACCURACY OF THE METHOD.

Probably the best way to test the accuracy of this method is to compute the deviations for the 8-inch converted rifle by this method and note how the result compares with the range tables for that gun, which are known to be very accurate. For this gun, M.V. $=$ 1414 f.s. The formula becomes for this value of $V$

$$D_{10} = (9.1788952-10)\ F(T)$$

For range 4,000 yards $T = 11.''14$.

Computed for 11″.

$\text{Log. } F(11'') = 1.9406808$

$\text{Log. coef. for gun } 9.1788952-10$

$\text{Log. } D_{10} = 1.1195760$

$D_{10}$ for 11″ 13.170 yds.

Computed for 12″.

$\text{Log. } F(12'') = 2.0058238$

$\text{Log. coef. for gun } 9.1788952-10$

$\text{Log. } D_{10} = 1.1847190$

$D_{10}$ for 13″ $=$ 15.301 yds.

$D_{10}$ for 12″ $=$ 13.170 "

Dif. for 1″ $=$ 2.131

Dif. for 0.″14 $=$ 0.298 yds.

$D_{10}$ for 11″ $=$ 13.170 "

$D_{10}$ for 11.″14 $=$ 13.468 "

The range table gives the deviation as 10.′7 of azimuth. The deviation in yards lies therefore between 12.39 yards and 12.64 yards. The difference is about 1 yard.

Required the value of $D_{10}$ for same gun for $T = 5''$.

$\text{Log. } F(5'') = 1.3326802$

$\text{Log. coef. of gun} = 9.1788952-10$

$\text{Log. } D_{10} = 0.5115754$

$D_{10}$ for 5″ $=$ 3.248 yds.

By range table $=$ 2.72 "

Dif. 0.528

These differences are of no moment for practical work. It is possible, however, that as the empirical formula, artillery drill regulations, was determined from firings with an M.V. of 2025 f.s. that we should have computed $M$ from that velocity instead of 2250 f.s. Had we done so, the values of $D_{10}$ for the two cases of the 8-inch converted rifle would have been as follows:

$D_{10}$ for ($T = 11.''14$) $=$ 12.240 yds. dif. from table by 0.22 yds.

$D_{10}$ for ($T = 5''$) $=$ 2.949 " " " " " 0.23 "

This would make log. $M = 1.6657120$.

## CONCLUSION.

While it is true that the values of log. $F(T)$ have been computed from data for the 12-inch B.L. rifle for a certain velocity, they are independent of all magnitudes that are functions of the gun, projectile or velocity. They are dependent only upon the fact that the empirical formula of the artillery drill regulations will give true results for some velocity. They have been very carefully computed and checked by differences to the fifth differences. These values are undoubtedly sufficiently accurate for all practical purposes. The only question of doubt is the value of $M$. This should be determined empirically with as much accuracy as possible. I believe that this can be done with the 6-pounder R.F. gun by firing through screens (targets), taking the time of flight electrically at each screen and measuring the deviation thereon. If this experiment were made at some southern station where trade winds prevail, there should be no difficulty in avoiding varying winds over the range, for the short ranges that would be required.

The value of $M$ should be determined for at least three different velocities differing by at least 300 f.s.

### TABLE I.

For determining the value of $A$.

| $n$ | $H$ | $H'$ |
|---|---|---|
| 0.5 | 0.5000 | 0.3927 |
| 1.0 | 0.9660 | 0.1526 |
| 1.5 | 1.1180 | 0.0863 |
| 1.6 | 1.1619 | 0.0782 |
| 1.7 | 1.2041 | 0.0717 |
| 1.8 | 1.2450 | 0.0661 |
| 1.9 | 1.2845 | 0.0620 |
| 2.0 | 1.3229 | 0.0567 |
| 2.5 | 1.5000 | 0.0409 |
| 3.0 | 1.6583 | 0.0311 |

$n$ = Radius of ogive in calibres.
$H$ = Length of head in calibres.
$H'$ = Length of rectangle the width of which is $d$, and the area of which is equal to the area of the longitudinal cross section of the head.

$L$ = Total length of projectile in calibres.
$A$ = Length of equivalent rectangle in calibres.

$$A = L - H + H'$$

EXAMPLE:—For the C. I. and A. P. shot for the seacoast guns. $L = 3.5$ and $n = 2$.

$$\begin{array}{rl} L = & 3.5000 \\ H = & 1.3229 \\ \hline & 2.1771 \\ H' = & 0.0567 \\ \hline A = & 2.2338 \end{array} \qquad \text{Log. } A = 0.3490443.$$

## TABLE II.

Log. $F(T)$ obtained from empirical data.

| $T$ | Log. $F(T)$ | $T$ | Log. $F(T)$ |
|---|---|---|---|
| 1 | 0 0000000 | 14 | 2.1191899 |
| 2 | 0.4855004 | 15 | 2.1692335 |
| 3 | 0.9201599 | 16 | 2.2157433 |
| 4 | 1.1541444 | 17 | 2.2591158 |
| 5 | 1.3326802 | 18 | 2.2998340 |
| 6 | 1.4623920 | 19 | 2.3381775 |
| 7 | 1.5797150 | 20 | 2.3744000 |
| 8 | 1.6917267 | 21 | 2.4087317 |
| 9 | 1.7861976 | 22 | 2.4413494 |
| 10 | 1.8681506 | 23 | 2.4724493 |
| 11 | 1.9406808 | 24 | 2.5021266 |
| 12 | 2.0058238 | 25 | 2.5305327 |
| 13 | 2.0649818 | | |

# ORGANIZATION OF PERSONNEL FOR THE CARE OF ELECTRICAL APPARATUS AT POSTS.

BY CAPTAIN HENRY C. DAVIS, ARTILLERY CORPS.

Not long since an artillery officer, a pioneer in the study of electricity as applied to artillery, in a letter to me, remarked, "the engineers are turning over electrical plants to the artillery and if, in a few years, these are not found in good condition it will reflect on us". The officer making this remark understood very well that without special attention and study the artillery would fail in this matter. He also recognized that this fact is probably not fully appreciated by the corps at large.

The electrical apparatus at our seacoast forts comprises boilers, engines, both steam and oil, dynamos, motors, storage batteries, primary batteries, telephones and search lights, and of late there has been added the telautograph. All these require attendants with special training to insure their efficiency. Electrician sergeants have been appointed, and one is assigned to each post regardless of its size and equipment. For small posts this is ample, but for larger posts, it is impossible for one electrician sergeant alone to attend properly to all the electrical plant. He must have assistants.

At this post there are six storage batteries in commission, one not yet set up and still others in contemplation. These are scattered over a distance of about a mile and a quarter in a straight line, with two charging stations. The communications cover the same distance. There are many telephones now in use, and telautographs are soon to be added. The H.P.F. system when completed will require still other instruments.

This is enough plant for the electrician sergeant to superintend. The word superintend is used advisedly, as he can do little else than see that the whole is kept in good condition by his assistants. He can scarcely do the work of running the engines, charging the batteries, attending to the lights at the different emplacements and to the search lights, and keeping in order the telephones and telautographs. His assistants must be able to do these things while he is the general "trouble man". These details are cited merely to indicate the necessity for skilled assistants to the electrician sergeants.

A study of the methods of the other branches of the service may be of advantage. When the engineers have a dummy engine to run, they employ an engineer and fireman; when the quartermaster's department installs a pumping plant of any importance, an engineer and fireman are engaged for that work alone, and if this station requires a night shift, an additional engineer and fireman are necessary. These engineers are skilled men employed at seventy-five to one hundred dollars per month. When the mines were turned over to the artillery, the chief of engineers wisely employed an electrician at one hundred dollars a month to care for the material until such time as the artillery could take care of it.

The employment of these men is a necessity and they should be skilled operatives. In the commercial world a man who runs an engine must have a license; moreover, he runs the engine and as a rule does nothing else.

What lesson is to be learned from this survey of our surroundings? It is this: skilled men are required in all technical work, and they usually attend to the work assigned to them and to nothing else. Applying this lesson to the case of the artillery, we find that whenever there is more than the electrician sergeant can attend to himself, he must have assistants who are capable of doing the work assigned them under his supervision. I do not believe it is either necessary or wise to employ civilians for this purpose, as we can find in the ranks of the artillery corps men abundantly able to care for our plants as specified above. The question is how can we bring these men and the work together.

In answer to this question I suggest that the first step is to make systematic search for the proper men, and if they are not to be found at the post where they are needed, effect a transfer from some other post. A search through the enlistment papers is a first step towards accomplishing this, and a trial of the men so indicated is next in order.

Having found the men who are sufficiently intelligent or have had the necessary experience, how are they to be handled? Before answering, it is necessary to consider what the difficulties are.

Men who possess the necessary qualifications are, as a rule, valuable in the organization to which they belong, and the captains are generally loth, and naturally so, to give them up for a duty that will, or ought to, take them away from the company. Again, the work assigned usually requires these men to be occupied during the greater part of the day. Major Anderson, in his handbook, states that if an attendant has not all of his apparatus in perfect order and has not worked ten hours a day he is not doing his duty.

In the company, soldiers who can do skilled work command detachments, point the guns, take charge of the company property, do the mechanics' work around the battery, or cook the food for the company, and are set aside from others by giving them chevrons and extra pay, while the assistants to the electrician sergeants have neither rank nor extra pay. Under the present conditions, the corps of electricial "experts" is panoramic in its character, for which there must be some reason. I believe it is a recognized fact that, as a rule, the artillery soldier does not re-enlist, and the task of keeping the electrical detail full of even moderately well qualified men is certainly difficult.

Suppose in action the generators or engines fail to do the work because of unskilled attendants, or the storage battery fails to light the emplacement, or the search light to illuminate the field of fire, or the telephones and telautographs fail to convey orders and ballistic data from the same cause; what becomes of our complicated system? A chain is no stronger than its weakest link. The electrical appliances are the nerves of the system, and if they are out of order the whole combination fails.

It seems very clear that the electrical detachment should receive more attention as to its personnel and handling than it now receives and, I might add, than is generally thought necessary. There are two methods that may be adopted to improve matters as they now stand, either one of which would, I believe, attain the desired end.

The first plan consists in organizing at each post an electrical detachment under the charge of the electrician sergeant composed of men who are qualified or give promise of qualification for electrical work. The detail to such duty will be made on application of the man after he has passed an examination as to his ability. The requirement that the detail shall be on application of the soldier insures the selection of men who have a taste for the work and who probably desire to perfect themselves in it. They should be in the second year of service at least, so that they may have had company discipline and all the necessary drill to appreciate the connection of their work with the service of the guns.

If a post does not furnish enough men of this class, or if a man desires such a detail and there is no vacancy for him at his post, the facts should be reported to the District Commander. The latter should, by communication with others, effect a transfer when necessary, but a man should not, as a rule, be transferred for this purpose unless he assents thereto. The underlying idea in the whole plan is to make the detail popular and so induce men of this class to re-enlist.

The members of this detachment should not be required to do any routine company or post duty, or attend drills at the guns. They should be inspected at their place of work at the same time as the plant is. They should receive the rank of electrician, wear a distinctive chevron and receive extra pay. They should be attached for rations, quarters and muster to one or more of the companies, but should attend only such roll-calls as the engineer officer under whom they serve shall designate as not interfering with their work.

The strength of this detachment will depend entirely on the equipment at the post considered. There should be one man for every detached storage battery and one for each engine of less than 15 horse-power. For a plant of greater horse-power, and with a storage battery, two men are needed. If there are three or more storage batteries to the generator, and hence considerable length of line of communication, there should be a line man in addition to those mentioned, while the electrician sergeant should supervise the whole. Although not stated, it is intended, also, that this detachment embrace those soldiers assigned to the care and preservation of the submarine defense material. The number necessary for this purpose will be suggested by the amount of plant.

The second plan differs from the first in a minor point, and is offered only for the reason that to carry it out does not require an Act of Congress or, it is believed, anything more than a post order, provided the co-operation of the company commanders is obtained. It consists in forming the detachment of corporals detailed to it under the same restrictions mentioned above. These corporals will be under the same regulations as to drills, etc., as the members of the detachment in the first plan, but in so far as practicable their work will be in connection with the electrical appliances pertaining to the battery to which their company is assigned. The co-operation of the company commanders is necessary in order that at least one such qualified man is appointed corporal in each company.

There is a third alternative suggested by me in a report of some two years ago; namely, to appoint electrician corporals in the same manner as electrician sergeants are now appointed, but in sufficient numbers to allow of a full complement of electrician non-commissioned officers at each post, one of whom is an electrician sergeant. If this plan be adopted, I would suggest that the graduates of the present school for electrician sergeant be each given a warrant as electrician corporal, and that vacancies in the grade of electrician sergeant be filled by selection by examination from the grade of electrician corporal.

This plan will not provide for the detachment for submarine defense. To cover that case, there may be one additional electrician non-commissioned officer detailed to each post to take charge of this work, having under him a detachment of men detailed on special duty under regulations, as to other duty the same as other special duty details at the post. This non-commissioned officer should have had a special course at the School of Submarine Defense.

It is proposed that the electrician detachment, however organized, be under the command of the engineer officer, who should also be signal officer and in charge of the submarine defense material. This concentrates all electrical work under one officer who, it is scarcely necessary to add, should be selected with regard to his suitability to the position.

# FRENCH RAPID-FIRE FIELD ARTILLERY.

## ITS MATERIAL, FIRING METHODS, AND MANNER OF EMPLOYMENT.*

COMPILED BY CAPTAIN ANDREW HERO, JR., ARTILLERY CORPS.

The appearance of the new French field artillery regulations may be called an event of marked importance. France is the first Power which has dared to adopt an absolutely *original* type of gun. A satisfactory field gun of great shell power, and with long recoil on the carriage which remains stationary from shot to shot, possesses such advantages that all nations be obliged sooner or later to equip their artillery with a material of this nature. The entire French field artillery is now equipped with these guns, and, in some cases, they have been in the hands of troops for over four years. They have been tested in maneuvers over every kind of ground and under the most adverse conditions in China, so that they have stepped beyond the experimental stage and the results aimed at by the inventor have been fully confirmed by the most extensive practice.

Therefore the new French regulations constitute an epoch-making work, not only because they give information about the gun itself but also, and what is more important, because they make known its manner of employment.

### THE NEW REGULATIONS.

The Provisional Regulations for Field Artillery Maneuvers approved by the minister of war on the 16th of November, 1901, superseded the Rough Draft of the Regulations for Field Artillery Maneuvers dated the 18th of July, 1898. The new regulations are composed of two parts, each one forming a special handbook of the same form as the scheme of 1898. The precepts relating to rapid-fire field artillery, the firing methods, and the employment of 75-millimeter calibre artillery, offer so much more interest and have so much more value now that they have been sanctioned by actual practice and experience, both on the proving grounds and in maneuvers extending over a period of four consecutive years. The first part of the regulations of 1901 is divided into seven sections:

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*The French "Règlement Provisoire de Maneuvre de l'Artillerie de Compagne" forms the basis of this article; but, in addition, the following have been consulted and freely used in its compilation:

Notes on the Construction of Ordnance.—No. 82.
Mittheilungen über Gegenstände des Artillerie-und-Geniewesens.
Schweizerische Militärische Blätter.
Proceedings of the Royal Artillery Institution.
Revue Militaire Suisse,
Revue d'Artillerie, and other foreign periodicals.

The cuts for the illustrations were obtained from the Public Printer, through courtesy of the Chief of Ordnance, U. S. A.

I.—General basis of instruction.
II.—Foot instruction.
III.—Artillery instruction.
IV.—Mounted instruction.
V.—Field and horse battery maneuvers.
VI.—Service of artillery in the field.
VII.—Inspections, reviews, honors, marches past.

The second part, which is a sort of complement to the first, resumes with new details most of the subjects of the first part. We there find:

I.—General basis of instruction.
II.—Portable arms.
III.—Artillery instruction.
IV.—Mounted instruction.
VI.—Service of artillery in the field.

Numerous plates show the material and give its nomenclature. These regulations apply to all field batteries armed with 75-millimeter guns, and they supersede all previous rules and instructions.

Sections I, II, IV, VI, VII apply likewise to batteries equipped with 80 and 120 millimeter guns, except as to the special dispositions relating to the 75-millimeter guns.

The essential parts of the regulations are: Section III, "Artillery instruction;" Section V, "Maneuvers of field and horse batteries;" and in Section VI (the chapters without titles), "Instructions for combat," "Practical instruction on the service of artillery on the field of battle." In Section III the school of the gunner has for its object the instruction of the cannoneers in all the individual operations necessary for firing. The school of the piece is an instruction which serves to coordinate the individual movements so as to assure the rapid service of the piece. The school of the battery has for its object the training of the personnel of each battery in fire discipline and in all the operations for the execution of firing. Although the regulations do not provide any school of section, the captain has the sections maneuvered under the commands of the chiefs of section. The section is then considered as a battery of two pieces. In Section V, "Maneuvers of mounted batteries," we find also the school of the battery, but from another point of view, and the "School of the group." The relations and the role of artillery scouts are there laid down with very special care. Such are in the main points, the general principles of these new regulations on the employment of rapid-fire guns provided with shielded mounts. The peculiar qualities, the service, the methods of fire, the mode of employment of the new artillery, are questions of great importance not only for artillerymen, but for infantry and cavalry, whose union with the artillery tends to grow continually closer.

But before describing in detail the manner in which the range is obtained and then the target is attacked, a brief description will be given of the gun, carriage, laying gear and sighting arrangements.

### FRENCH 75-MILLIMETER (2.95-INCH) R. F. FIELD GUN.

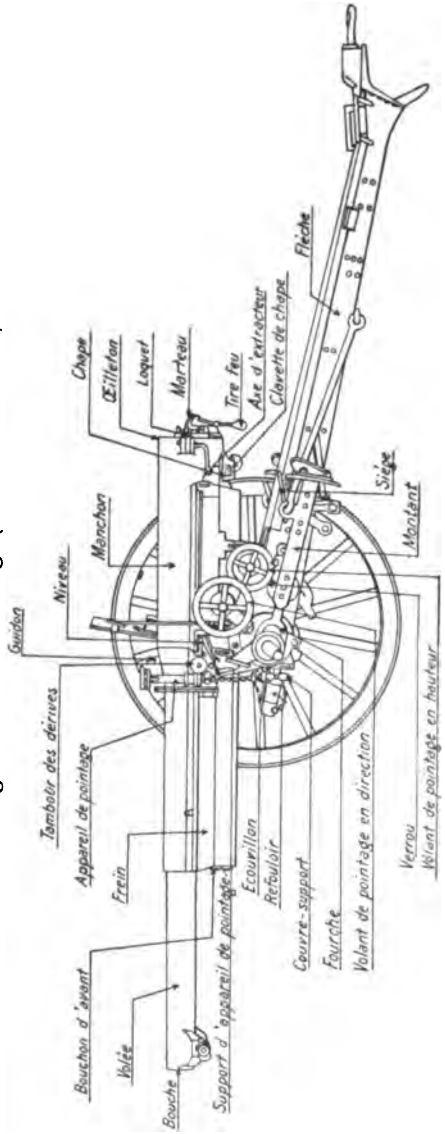
Chapter 1 of the section entitled Artilllery Instruction, Part 2, bears the title Description of Material. This chapter, however, consists only of the plates of the material and its parts (the principal plates are reproduced herewith), giving the nomenclature throughout. But succeeding chapters contain very exact and definite directions for dismounting various parts, for the care of the gun, carriage and accessories, and a complete form for both general and detailed inspections, showing what is to be examined and the mode of examination. From study of these chapters in connection with the plates, the following description has been obtained.

GUN.—Certain figures given in the regulations point to the M. V. being about 1640 f.s. Accounts published in Germany have also given this as the M. V. The gun appears to be about 117 inches long, or nearly 40 calibres.

The tube is of nickel steel, and on this is shrunk the long breech hoop of steel and a jacket of bronze. The gun slides on a slide-way (glissière) of the top carriage and is connected at the breech end to the recoil-brake which allows of about 42 inches recoil. On the right-hand side near the breech are two marks on the gun; one of these, in connection with a mark on the recoil-brake, shows when the gun is fully run out, and the other shows how far the gun may be from the fully run out position and yet be safe to fire. (See fig. 5.)

Under the muzzle, symmetrically arranged on the right and left sides, are two muzzle rollers (galet de la bouche, fig. 2), and under the jacket, attached to the gun, are the jacket rollers. The gun also carries the roller covers and their springs. There is small peep-hole on the highest point of the breech (oeilleton, fig. 1 and 3) which, with the foresight on the jacket (guidon, fig. 1) constitutes a fixed line of sight parallel to the axis of the piece.

Fig. 1. Gun and Carriage (left wheel removed).



ENGLISH NOMENCLATURE.

Foresight.
Micrometer-head. Level. Recoil-brake Lug.
Front Screw Plug. Laying Apparatus. Jacket. Window Sight (peephole).
Chase. Recoil-brake. Retaining Latch.
Muzzle. Hammer.
Support of Laying Apparatus.
Sponge. Lanyard.
Rammer. Extractor Axis.
Cover for Socket for Support of Laying Apparatus. Key for Recoil-brake Lug.
Fork of Stay (of Tyre-brake). Flask of trail.
Traversing Handwheel. Seat.
Clamp. Fork Stay (of Tyre-brake).
Elevating Handwheel.

This can be used for roughly giving the piece direction, but it is mainly used for verifying the laying apparatus.

*Breech mechanism.*—The breech mechanism is of the eccentric-screw type Nordenfelt system (see figs. 3, 4 and 5, which explain its chief features).* It is worked by the firing number who depresses the lever to close the breech, but the first motion of closing is given by the act of pushing in the cartridge; this motion should not be checked by the firing number or the

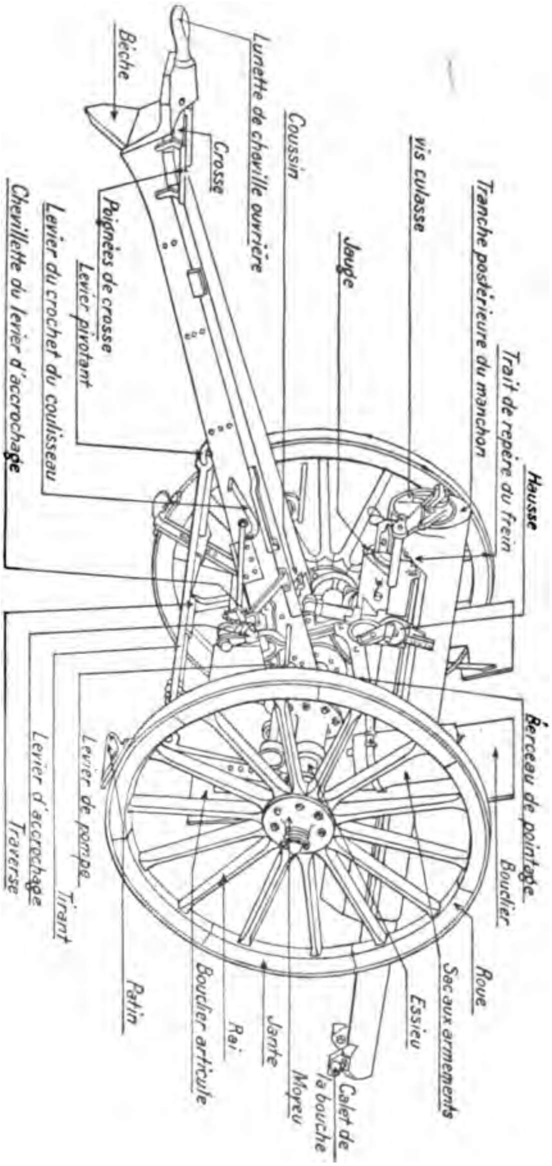


Fig. 2. Gun and Carriage, right side.

ENGLISH NOMENCLATURE.

Graduated Range Disk.
Indicator Mark on Recoil brake.
Rear face of Jacket.
Breech screw.
Gauge (of recoil-brake).
Pad.
Lunette.
Trail.
Spade.
Trail handles.
Lever of Tyre-brake.
Lever of Sliding Hook.
Key of Securing Lever.
Cradle.
Shield.
Wheel.
Small Store Case.
Axle.
Muzzle Roller.
Nave.
Felly.
Spoke.
Hinged Shield.
Shoe.
Pump Lever.
Stay (of tyre-brake).
Securing Lever.
Crosspiece (of tyre-brake).

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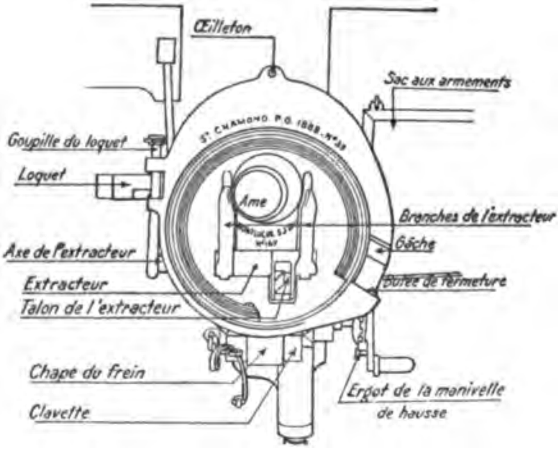
* See *Journal U. S. Artillery*, Vol XVII., No. 1.

cartridge may rebound. He fires the gun by pulling the lanyard which hangs close to the lever (see fig. 5). The breech mechanism is provided with a safety stop which prevents the possibility of the cap being struck when the gun is limbered up loaded. The lever of the breech block is provided with a catch to lock it when the breeck is closed; on firing, this catch unlocks itself; it can, however, be unlocked by hand.

Fig. 3. Breech End of Gun.



English Nomenclature.

Window Sight.
Small Store Case.
Retaining Latch Pin.
Retaining Latch.
Bore.
Extractor Arms.
Recess for Locking Catch.
Extractor Axis.
Extractor.
Heel of Extractor.
Stop for Breech Lever.
Recoil-brake Lug.
Hook of Elevating Lever.
Key.

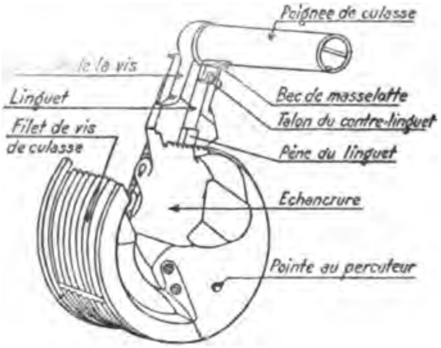
Carriage.—For convenience of description the carriage may be divided into 5 parts: 1. Lower carriage and traversing gear; 2. top carriage and cradle; 3. elevating gear; 4. appliances for limiting recoil, and accessories; 5. laying apparatus and instruments for laying.

1. The body of the carriage consists of two flasks of sheet steel united by several transoms and a top plate. The trail terminates in a fixed spade. It has also two trail handles and a lunette which is free to revolve in the socket attaching it to the trail (fig. 2.). There is no trail handspike. At their forward ends

the flasks are bolted to a forged steel axle sleeve (couvre-essieu, fig. 6) which carries the uprights to which the shields are fastened, and slides on the axle (essieu, fig. 2.) of the carriage. At the heads of the flasks are the trunnion beds for the top carriage.

For careful laying in direction and in certain kinds of fire, the whole carriage including gun is made to move on the axle. The axle bears a ratchet along the part covered by the axle sleeve. A gear contained in a metallic sphere and controlled by the traversing hand wheel on the left side of the carriage, works in this ratchet and causes the carriage to pivot on the spade and move on an arc to the right or left. Each turn of the traversing handwheel displaces the point of fall of the projectile by a horizontal distance equal to about $\frac{2}{1000}$ of the distance from the gun to this point of fall.* The total play along the axle corresponds to 52 turns of the traversing handwheel, 26 to the right or left, each side of the centre. The piece can therefore be aimed by by means of the traversing gear upon all points on a front equal to about $\frac{1}{10}$ of the range. At a range of 2,000 metres, for example, this front would be 208 metres.

Fig. 4. Breech Block.



ENGLISH NOMENCLATURE.

Breech Lever.

Locking Catch.
Thread of
Breech Screw.

Handle of Brech Lever.

Tooth of Plunger.
Claw of Locking Catch.
Bolt of Locking Catch.
Breech of Opening.
Point of Striker.

2. The top carriage supports the piece and, with its guiding slide, inclined surfaces and roller paths, forms the bed upon which the piece recoils and returns in battery after firing. It

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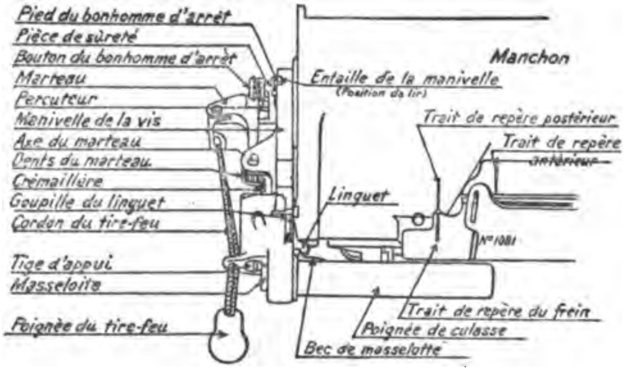
*More exactly 2 millièmes, a unit that will be explained later.

comprises also the recoil-brake. The gun is fastened to the brake by a lug and key, which join the jacket to the piston rod of the brake (fig. 3.). This key cannot be taken out when the breech is closed, as a safety bolt prevents its removal; and when the key is out, the breech cannot be closed. In this way the gun is protected from being fired accidentally when the key is not in position.

Fig. 5. Breech Lever, Firing Mechanism, etc.



ENGLISH NOMENCLATURE.

Toe of Catch.
Safety Stop.
Knob of Catch.
Hammer.

Striker.
Breech Screw Lever.
Hammer Axis.
Teeth of Hammer.
Toothed Rack.
Pin of Locking Catch.
Lanyard.
Guide Stalk.
Plunger.

Lanyard Toggle.

Jacket.
Notch in Lever.
(Firing Position.)

Rear Mark (on gun).
Front Mark (on gun).

Locking catch.

Indicator Mark on Recoil-brake.
Handle of Breech Lever.
Tooth of Plunger.

Under the gun in front of the jacket there is fixed a steel plate called the "frotteur," with guide-block which engages in the guiding slide (glissière) of the top carriage. This plate and block serve to hold the gun in the top carriage and also limit the motion of the piece to the rear.* Side plates (frotteurs lateraux) also fastened to the piece at this point, bear perpendicularly against the inclined surfaces of the top carriage and are provided with felt washers which clean the slides as the gun recoils, and prevent dust and dirt from getting in.

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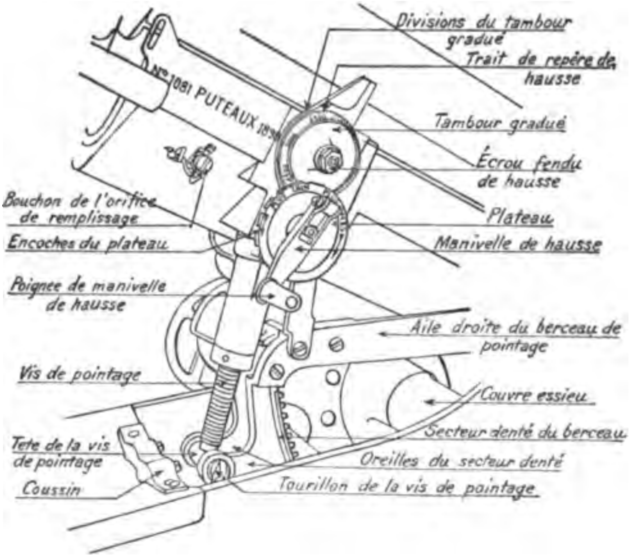
*Very strict injunctions are laid down as regards the precautions to be observed in unkeying the piece from the recoil-brake, and in dismounting the frotteur and its guide-block (coulisseau). The piece must not be unkeyed when the frotteur etc. is not in place, and conversely, the frotteur etc., must not be dismounted if the piece is unkeyed. In both operations the piece must be practically horizontal.

The two trunnions of the top carriage rest in the trunnion beds at the heads of the flasks of the lower carriage. Turning about them in these same trunnion beds are the two half trunnions of the cradle (berceau de pointage, fig. 2.) which consists of two arms extending from the trunnions to a point in rear and enclosing at their rear end a toothed arc (secteur denté du berceau, fig. 6.) in which the elevating gear engages.

Fig. 6. Top Carriage, Cradle, Graduated Range Disk, etc.


Divisions du tambour gradué
Trait de repère de hausse
Tambour gradué
Écrou fendu de hausse
Plateau
Manivelle de hausse
Aile droite du berceau de pointage
Couvre essieu
Secteur denté du berceau
Oreilles du secteur denté
Tourillon de la vis de pointage
Bouchon de l'orifice de remplissage
Encoches du plateau
Poignée de manivelle de hausse
Vis de pointage
Tete de la vis de pointage
Coussin
Nº 1081 PUTEAUX 189

ENGLISH NOMENCLATURE.

Stopper of Filling Hole of Recoil Brake.
Notches of Disk.
Lever Handle.
Elevating Screw.
Head of Elevating Screw.
Pad.

Divisions of Graduated Range Disk.
Setting Mark of Graduated Range Disk.
Graduated Range Disk.
Split Nut.
Disk (fixed).
Elevating Lever.
Right Arm of Cradle.
Axle Sleeve.
Toothed Arc of Cradle.
Lugs of Toothed Arc.
Trunnions of Elevating Screw.

3. There is a double elevating gear wholly peculiar to this French gun. A part enables the piece to be elevated or depressed with respect to the cradle; the other part elevates or depresses both cradle and top carriage bearing the piece.

The top carriage bearing the gun is connected with the cradle at its rear end by an oscillating support consisting of an elevating screw along which moves a nut that is fastened to the top carriage. The head of this elevating screw terminates in journals or trunnions which bear in lugs on the toothed arc of the cradle. Thus the piece, along with the top carriage, can be given a varying inclination in the vertical plane to the cradle. These angular movements of the top carriage with reference to the cradle are controlled by the elevating lever and its handle (manivelle de hausse and poignee de ...) on the right side of the piece, which through gearing causes the nut to turn and thus varies the length of the oscillating support. This angular movement is measured by a graduated range disk which for convenience is inscribed not with the angles but with the corresponding ranges from 0 to 5,500 metres. A setting mark on the gun indicates the reading. The elevating lever has a hook which must be disengaged from the corresponding notches of the fixed disk (plateau) before the range disk can be turned. For travelling the range disk can be locked by a bolt.

The cradle together with the top carriage, and hence the piece, can be elevated or depressed by a gear which engages in the toothed arc of the cradle. This gear is worked by the elevating hand wheel (fig. 1.) on the left side of the piece. One turn of this wheel causes the arc to move through one degree. The circumference of the wheel is marked by 16 divisions, each one corresponding to practically one millième, that is, about $\frac{1}{1000}$ of the range. This is of great value in progressive fire intended to cover a certain area; for example, at 3000 yards half a turn would change the range $\frac{8}{1000} \times 3000 = 24$ yards.

4. RECOIL-BRAKE.—The *Règlement* is absolutely silent as to the internal details of the recoil-brake; there is nothing said to show whether it is a hydraulic or a hydro-pneumatic brake; the general weight of evidence available seems to point to its being the former.* Recent German accounts designate and describe it as hydro-pneumatic.† The following is taken from the *Règlement*.

In order that the brake should function properly in firing under normal conditions, and in order that the gun should not recoil or slide back on the top carriage on the march due to shock,‡ it is necessary and is sufficient that the body of the brake be full of oil.

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*L. R. Kenyon, R. A., Proc. R. A. I. 1902.

†Mitth. Art. u. G. No. 10, 1902.

‡It is very important that the piece rests in battery on the march; if it recoils appreciably the jacket rollers might rest on the roller paths, which it is essential to avoid.

To provide for any loss of liquid that might occur, the brake should contain a small supplementary quantity of liquid which is called the reserve. When this reserve is exhausted, loss by leakage, etc., takes place at the expense of the strictly necessary oil, and the piece, in firing, may not return completely in battery, or on the march may slide back on the carriage.

There is no danger in continuing a series of rounds with a gun when the return in battery is not complete, so long as this lack of return does not exceed 6 or 8 cm. (the limiting marks are on the gun and brake, see fig. 5.); hence a "rapid-fire" can be terminated before recharging the brake.

The amount of reserve liquid is indicated by the gauge (fig. 2.) at the rear of the brake; if the gauge is far in, oil is needed; when the reserve is of the proper amount, the gauge is at the index marked on its seat. To make provision against loss of oil in the brake, a certain quantity of this liquid is carried in a reservoir between the flasks of the carriage. This quantity is sufficient for a campaign even of long duration. Each gun-limber carries, also, a can containing 2.2 lbs. of oil. To this reservoir is attached a pump, the handle of which is fixed to the right flask (fig. 2.). The tube from the pump connects with the brake, and when the gauge shows that the latter needs charging, the pump is worked unitl the gauge comes to the index. If the gauge shows that there is too much oil, the excess is removed by unscrewing the stopper of the filling hole (fig. 6.). If the pump will not work for any reason, a syringe with a screw nozzle is provided which fits the bushing of the filling hole.

Very detailed and strict instructions are given as to what parts of the mechanism may be stripped by the battery artificers; many of these operations are only to be performed in the presence of an officer, and it is absolutely forbidden to attempt to strip the recoil-brake.

Tyre-brakes are provided which are hooked up for travelling, and are let down, as in fig. 2. for firing. These brakes can also be used as road brakes. The form of the brake and the shape of the shoes can be clearly seen in fig. 2. It will be observed that the shoes are provided with spades so as to resist lateral displacements. The fork-stay that connects the crosspiece bearing the shoes with the axle is shown in fig. 1; the fork, as there shown, terminates in an eccentric ring embracing the axle.

To put these brakes in action, the trail is lifted up and the shoes are let down; when the trail is lowered again, the wheels ride up on the shoes.

The first round fired sends the carriage back until the spade at the end of the trail is driven into the ground. The shape of this spade, it will be observed, is such that it prevents the force of recoil from sinking the trail further in the ground after it is once in position.

The carriage comes back about 15 inches in the process of setting the wheel brakes, and the first round sends it back about 4 more inches by driving the spade in; the carriage should, therefore, be brought up 19 inches in front of the position it is actually to stand in; this is of importance, as the easy passing of the ammunition from the wagon depends upon the gun and wagon being close alongside of one another. To limber up, the gun must first be run forward off the shoes; the shoes are then lifted up and secured. Fig. 1 shows the brakes secured for travelling.

SHIELDS.—There are two shields, one on each side of the gun, supported by the flasks of the lower carriage. The shields project a few inches above the wheels, and the lower halves are hinged and are fastened up on the march. There are of chromium steel, about 0.2-inch thick. The left-hand shield has an opening for the laying apparatus, and a small supplementary shield is placed in front of this apparatus to protect it. On the rear face of the right hand shield is strapped a small store case or armament bag (fig. 2 and 3.) which contains tools, an extra level and extra laying apparatus (more than one is indicated in the regulations but the number is not stated).

The piece is provided with a sponge and rammer carried in cases under the carriage. On the top plate of the trail up under the breech, there is a small pad or cushion (coussin, fig. 2 and 6) on which the breech end of the recoil-brake rests during marches. There are also on the trail two seats, one on the right for the firing number who sits facing the breech, and one on the left for the number pointing the piece. A knee-guard protects the firer from being struck by the breech handle when the gun recoils. Cast on the left arm of the cradle is a place for the support of the laying apparatus or sighting mechanism. On the march, the laying apparatus is kept in the armament bag and this support is provided with a cover (fig. 1.) which is then used to keep out mud and dust.

We will group the laying apparatus with the other instruments used in laying, and as their description and use will be better understood when considered in connection with the operations of aiming and the firing methods employed, they will be considered in a subsequent paper.

[To be continued.]

# ELECTRICITY IN PERMANENT SEACOAST DEFENSES.*

BY MAJOR GEORGE W. GOETHALS, U. S. A.

In order to understand the history and conditions governing the installation of electrical plants for use in connection with seacoast defenses, which is the subject of this paper, a few remarks explaining the actual conditions of a military post on the coast may not be amiss. Along our seacoast there are certain harbors from which, for strategic reasons, it is desired to exclude an enemy by means of properly constructed defenses. To accomplish this object, sites are procured from which command of the approaching channels may be had, and these sites are designated as forts or posts. On these sites are scattered the guns of various calibre, either singly or, more frequently, in groups of two, three, etc., as the extent of the site and the proper command of the channel may require.

An emplacement is understood to mean that part of a battery occupied by one gun, including the platform on which the gun is mounted, its magazine, shell-rooms, storerooms, offices, etc. Two or more emplacements constitute a battery. A fort is an aggregation of batteries, together with barracks, hospitals, quarters, storehouses, etc., and such buildings as are needed for the administration, operation and care of the batteries. To the Corps of Engineers is entrusted the construction of the emplacements and batteries, together with the installation of such power as may be needed to light them and to operate the motors connected with the ammunition service and the maneuvering of the guns. On their completion, the works of defense are transferred to the artillery branch of the service for operation and care.

In the earlier emplacements and batteries no provision was made for using electricity, not because the desirability of its use was not considered or understood, but from a desire to mount as many guns at various localities as possible, using the very limited appropriations received from year to year for this purpose rather than for purposes not absolutely necessary. As the works for defense advanced, small available balances were expended for lighting batteries already completed, or nearly so. Where the emplacements offered available room, such plants were installed in the battery ; when such was not the case, small power-houses were constructed near the batteries for the purpose, and in some cases two or more batteries were lighted from the same plant, but this was rather unusual. Such plants were necessarily small, operated in some cases by steam power, when the smoke stack or steam escapement could give no possible clue to an enemy, but in the majority of cases they were operated by a gas engine. The lamps ranged in voltage from 80 to 110 ; generators, switchboards, etc., were arranged to suit the particular conditions at the battery under considerations and the money available. These plants were provided with a small storage battery as a reserve, to obviate the necessity of operating the entire plant every time the lights were desired, and in their entirety were so simple that an intelligent enlisted man was able to operate them.

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* Reprinted from *Transactions of the American Institute of Electrical Engineers.*

The number of such plants installed was comparatively small, and the subject had been regarded as rather in an experimental stage, but sufficient experience had been had to warrant a serious consideration of the subject, with a view to applying electricity in all gun batteries for furnishing light and also for supplying power to raise the projectiles of the larger calibred guns from the level of the magazines or shot-rooms to the gun platforms. The desirability of uniformity in the plants was also apparent and to secure this as far as practicable, a board of engineer officers, consisting of Major Smith S. Leach, Lieut. J. C. Cavanaugh and Lieut. R. R. Raymond, all of whom had had experience in installing and operating plants in connection with for fortifications, was convened for the purpose of considering the application of electricity for furnishing light and power to the batteries, and to make such recommendations as would accomplish the desired results, and at the same time to prepare specifications which could be followed in all future work. Thus far, it must be understood, the emplacement lighting and the power for operating the ammunition hoists were alone considered, so that the conditions that such installations were designed to meet were : intermittent service, inexpert and non-continuous attendance, and exposure of the generator and switchboard apparatus to the moisture of the emplacements, since complete protection against all kinds of fire from a hostile fleet was advisable.

While centralization was considered desirable, it was not to be carried beyond the limits within which the standard voltages of all parts of the system could be maintained with a reasonable expenditure of copper, so at some posts where the batteries were considerable distances apart there might be two or more plants. The power-houses were to be in one of the batteries, if room were available, or in a bomb-proof structure built for the purpose and to be divided: for steam plants, into rooms for boilers, for engines and generators, and for accumulators; for oil engines, into rooms for engine and dynamo, for cooling tanks, if required, and for accumulators. The oil engine has given considerable trouble where used, because the engine did not accommodate itself quickly to fluctuations in the load, and on account of the impossibility of securing men in the immediate vicinity competent to take care of the engine and to make repairs in case of an accident or injury. Consequently, the steam plant was advocated.

The considerations which guided this board in the mechanical and electrical details were stated as follows:

1. The greatest probability that the plant would be ready for service at any future time, having in view simplicity of design and freedom from deterioration.

2. Uniformity of methods of operation and of methods of construction, so far as the latter involved the former.

3. Economy of operation.

4. Economy of first cost.

5. High commercial efficiency.

A vertical boiler and a generating set, consisting of a vertical high-speed engine direct-connected to a direct current, compound-wound, multipolar dynamo, the engine and dynamo resting on a common bed-plate, were recommended for all future installations. Reserves were recommended in the form of acumulators and were to be installed in all batteries, of 6-inch calibre guns or greater, their capacity to be determined by the lighting load only, without reference to the power load represented by motor-driven machinery, as the hand-operating devices were in themselves a satisfactory reserve. Reserves for the batteries to the smaller guns were to be made portable. The reserves were to be distributed so that a single accident or injury would not disable both the generator and the reserves at the same time, and also in order that any injury to outside wiring leads to the central generating plant could not disable the reserves. Under these conditions, the reserves were distributed among the various batteries, the reserve for each battery being sufficient in capacity for the lighting load of the particular battery with which it was connected.

The accumulators were arranged so that they could be divided into two equal parts for charging in parallel and discharging in series, the voltage during both charge and discharge being regulated by means of rheostats. This arrangement has many advantages for fortification work. No change is required in the normal voltage at the bus-bars, thus enabling the lights and motors to be operated while the accumulator is being charged, and in the central plant, all the accumulators may be charged at their normal rates, irrespective of their condition as to charge, without interfering with any of the motors or lights throughout the installation. The generators may be of a standard commercial type, a special winding for raising the voltage during the charging of the accumulator not being required. The danger of discharging the accumulator through the generator is reduced to a minimum, since the counter electro-motive force due to the accumulator in parallel is much below the normal voltage of the generator. The greatest disadvantage of this method of charging is its low efficiency, which, while a serious objection in commercial practice, is of less importance in fortification work. Glass jars were advocated as containers for the electrolyte, and these were to be placed on cushions made of hard rubber, so as to distribute the weight and prevent strains due to changes in temperature.

While uniformity was considered desirable in all parts of the installation, the board was of the opinion that the identical arrangement and operation of all switchboards was so very desirable that it should be insisted upon in all future constructions. The chief requirements are a dry and clean situation, high insulation and protective appliances, and the reduction of the number of manipulations required to the lowest possible limit. The board presented and recommended for adoption standard panels for generators and accumulators. A drawing of this type is appended in Figs. 1 and 2. For each installation there are required one generator panel and as many accumulator panels as there are reserves, the generator panels to be installed in the power room and the accumulator panels with the reserves. The generator panel is provided, in addition to the usual measuring instruments, feeder switches, etc., with cut-outs and fuses to protect the generator from over loads. The cut-outs are designed to open with 25 per cent overload and the fuses to blow with 50 per cent overload. The magnetic overload protection is in two separate instruments not to be operated simultaneously, so that one is free to act during the closing of a circuit, should a short-circuit exist. One of the cut-outs is provided with an underload attachment, to protect the dynamo from the discharge of the accumulators. The accumulator panel is provided with a triple-pole, double-throw switch, making all the connections for charging or discharging the battery, as is desired, and also to protect the generator on discharge from short-circuit by breaking one pole of its leads. Both ammeters are double-reading and on charge each records the current in one-half the battery; on discharge they are in series and both record the rate of discharge. The pilot lamps are connected across the bus-bars, and will not light up when the triple-pole switch is in position "Charge," unless the generator is in operation ready to charge the accumulator.

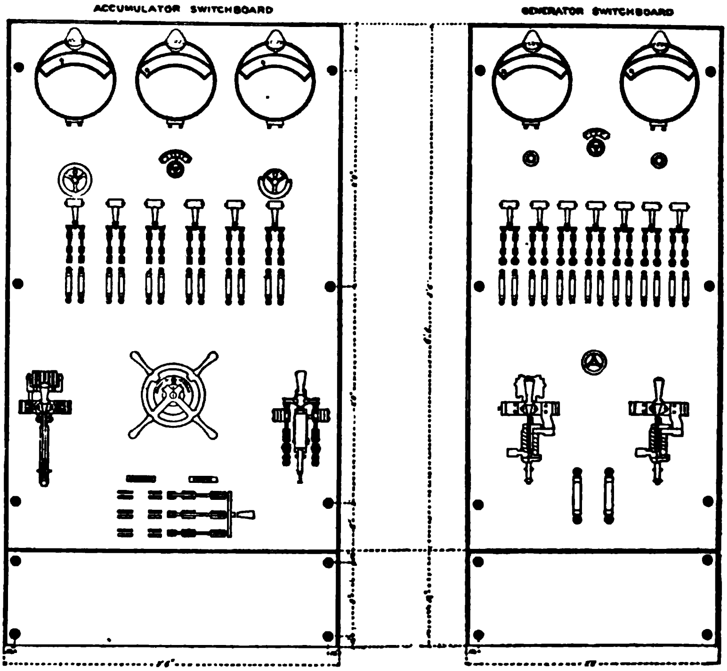

FIG. 1.

In this system, a circuit of 110 volts is adopted for the lamps and motors, and the maximum drop in the installation of any single-gun battery is to be restricted to two volts, if practicable, thus giving a normal voltage of 112 at the bus-bars of the accumulator panel, from which the lights and motors are supplied. In the central plant, the voltage of the generator is limited to 115 volts, if practicable, to minimize the fluctuations of voltage at the accumulator bus-bars due to variations in loads, and the conductors from the central plant to the several batteries are so proportioned as to give the same drop from the generator to each of the accumulator panels when carrying the normal loads.

Overhead wires were advocated wherever they could be obscured from the enemy's view, and for this purpose ordinary weather-proof wire with high grade insulators on stout poles was advocated. If the conditions of the ground were such that an aerial line could not be concealed from view, the cables were to be placed underground, carried in well-laid vitrified conduit at a depth sufficient to give ample cover. The specifications which resulted and which form a part of the report of this board will be found in Professional Papers No. 27, Corps of Engineers. They have been regarded as rather severe in their requirements as to boiler, generators, wire, etc., but in work of this character it is absolutely necessary that the best practicable types of machines be installed, for, as competition is required by law, it is better that the requirements be severe than that an inferior plant be

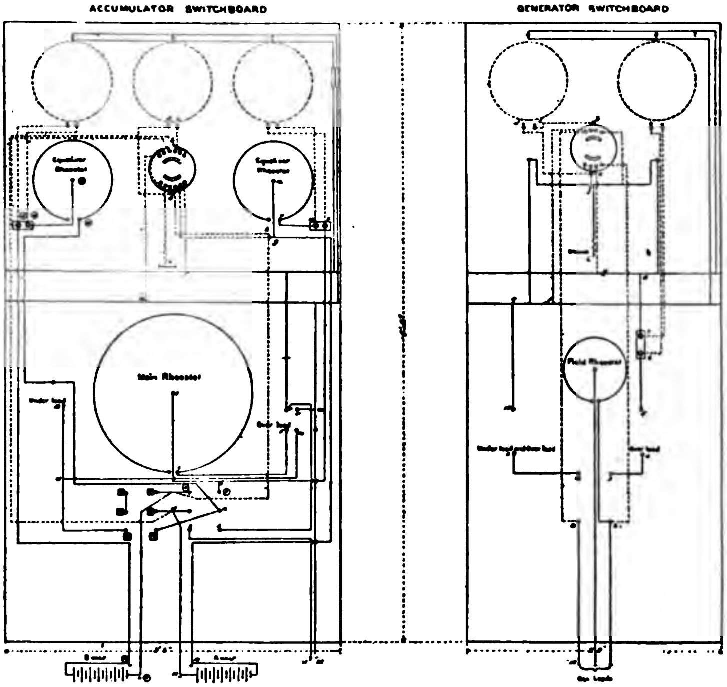

FIG. 2.

forced for acceptance with the liability of failure at a most critical time.

Shortly after the issue of the report of this board and the standard specifications, combined naval and land maneuvers were undertaken at Narragansett Bay, R. I. The importance of the searchlight up to this time had not been fully appreciated, and though they were provided at the various defenses for the purpose of guarding the mine fields against a night attack, their use in connection with the batteries had received but little consideration. As a result of these maneuvers, the necessity of searchlights as an adjunct of defense was established and another factor was introduced. Future plants would have to furnish sufficient power not only for emplacement work, but also for searchlights, and this addition required an increase in the capacity of the machines to meet the greater demand. The conditions and requirements as laid down by the board remained as yet unchanged. In the two services now to be provided, the emplacement service and the searchlight service, there was this difference: electricity

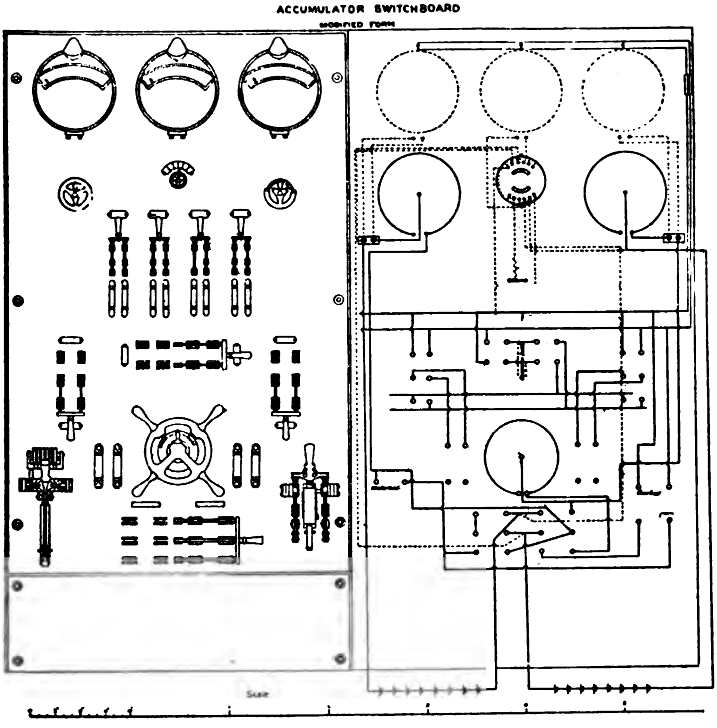

FIG. 3.

was absolutely necessary for the operation of the latter, while in the former it was not essential, since lanterns could supply the lights and manual labor could work the ammunition hoists and the guns.

Thus far, the plants installed were used for emplacement work only, the storage batteries were charged and discharged at stated intervals and, as noted above, the service was intermittent. The plants were in the hands of the Artillery Corps, and the officers desired to avail themselves of these plants for lighting their quarters and posts, thereby insuring, by their constant use, better care. As a result, the War Department authorized the use of such plants, if of sufficient size to do this work, by the Quartermaster's Department when authorized by the Chief of Engineers, "provided that the needs of defense shall have precedence over post lighting or power supply in any case in which both uses are simultaneously desired." It was further ordered that in future, when funds permitted, the Engineer Department should construct such ducts, service wires, etc., as might be necessary to deliver current to the buildings and to the exterior lights. The Quartermaster's Department was to wire the buildings, furnish the exterior lamps and to supply all plants used for post lighting with the necessary materials and funds for their repair and preservation. A third service was thereby imposed.

The Quartermaster's Department and the Artillery Corps desired for such lighting of posts low potential service throughout, mainly on the ground of simplicity and because of the character of labor that was to be employed in operating the plant; a centrally-located plant, due consideration being had to protection against hostile fire, accessibility for supplies, etc; that the plant be sufficiently large for doing all the work connected with the fortifications, and alternately for post and building lighting (in other words, the larger of these two services would govern the size, assuming direct current machines to be used); that the generator unit be sub-divided, thereby providing two engines and generators, so that in case of injury to either half, the other would be available for the more necessary purposes; and, finally, that all wires be underground rather than overhead, in order to reduce the cost of maintenance. With these additional services, the original conditions were changed, the whole subject required consideration anew and the matter was referred, by the Chief of Engineers, to a board of officers of the Corps of Engineers consisting of Major Smith S. Leach, Major S. W. Roessler and the writer, to consider the entire subject from the new standpoint, including the wishes of the Quartermaster's Department and of the Artillery Corps in the matter, and to modify the requirements as originally provided for fortification purposes as the new services necessitated.

The fullest possible electrical demand at any military post will embrace, therefore:

1. Searchlight service.
2. Emplacement service.
3. Garrison service.

And the engineer officer must design his plant for these three services.

The searchlight service requires current for a number of searchlights to be used in conjuction wirh the batteries placed in their vicinity. The number and size of these lights for any particular post is definitely known in advance.

The fortification service requires current for lights in the various rooms of each emplacement, on each gun platform, in the range-finding stations; current for power to work the motors for ammunition service, for traversing, elevating and depressing the guns and to operate a machine shop for minor repairs to the guns and carriages, and, finally, current for the recently adopted telautograph system connecting the range-finder stations with each other and with their respective batteries.

The garrison service requires current for lighting the grounds and buildings, including barracks, quarters, hospitals, storehouses, etc., which may be in close proximity to the batteries or at considerable distance from them, depending on the size and configuration of the reservation.

From an examination of a number of proposed projects, it is ascertained that the first and second of these services will, on the average, be of the same kilowattage or nearly so, and that the third will rarely exceed the same amount, in the majority of cases being less. The nature of the third service is not the same as the other two. The searchlights are to be operated only at night and can be operated only by electricity, and their continuous and perfect operation is a paramount exigency of the defense. Partial efficiency does not produce partial results. If the searchlights do not operate perfectly and continuously, they are of comparatively little use. The accumulator reserve alone is not satisfactory for this service, since a battery of reasonable size cannot supply the searchlights for more than eight hours, which might not suffice for making repairs. Should any mishap occur to the generating plant, it is probable that the searchlights would be put out of action. On account of these considerations, the board recommended that the generating plant, so far as the kilowattage was concerned, should be mechanically duplicated, boiler, engines and dynamos and, as a mechanical reserve is not always instantly available, in order that the searchlight might be kept in operation while the duplicate plant was being started, that the accumulator reserve should be made available for this purpose. It will be used a comparatively short time and an unusual size will not be required. The emplacement service will be required only while the guns are in action actually, or simulated in drill. At such times, this is a convenience only, not a necessity, since non-electrical reserves are provided for handling ammunition and may also be arranged for lighting. An accumulator reserve is practicable for this service, since a battery of reasonable size may be made to supply the more urgent needs of the emplacements for several days, and its instantaneous availability and its ease of subdivision are advantages over a mechanical reserve. Both searchlight and emplacement services are on a non-commercial basis, and economy of operation is a consideration of comparatively little weight.

The garrison service will be required during the hours of commercial illumination and will be of constant service during peace, probably discontinued during war. Garrison service considered alone should have the same weight given to economy of operation as in commercial lighting, and the use of reserves, accumulator or mechanical, should be considered mainly from the standpoint of use. The conditions are changed when this service is connected with the other two in the same installation. Both mechanical and accumulator reserves are required for the emplacement and searchlight services, and they are available for the garrison service, their use in that service depending so far as may be upon economy of operation. Current used from an accumulator is very costly, and when the variations of load, cost of fuel and local conditions are known, a simple computation will show whether it is desirable to supply the current in the hours of light load from the accumulator or to run the generator during the full hours of service.

For supplying these three services, the central power station is now adopted, its location depending on local conditions, and it must be so constructed as to be proof against hostile fire. The vertical boiler, in most cases, must give way to a more efficient type; horizontal engines must in some cases replace the vertical and they must be compound or condensing, depending on the local conditions; and the direct connection of the engine and generator, while still preferable, is not essential. The minimum capacity of the generating plant should be twice the normal demand of the searchlights, and, as stated above, should be in two equal, wholly independent parts, either or both of which may be subdivided as the local conditions indicate. Connections should be made to permit either part to supply the searchlights, giving complete mechanical duplication for this service by dispensing with the others.

Great difficulties will at times be encountered in attempting to furnish adequate garrison service at reasonable cost by using direct current. This is also true when in any particular case two forts are sufficiently near each other to warrant the consideration of one plant doing the work of both, and these difficulties are to be overcome by the introduction of alternating current for garrison service. The condition is imposed that if alternating current be adopted for garrison service, it shall be supplied from the same plant that supplies the emplacement and searchlight services, which require direct current.

The method suggested by the Board for consideration in the accomplishment of this result is by introducing a motor generator into the garrison feeders, taking direct current from the generator and delivering alternating current to the line at 1,000 or 2,000 volts, according to the distance of the transmission. Static transformers, according to the usual commercial practice, will reduce the voltage to 110 for delivery to the lamps. The objections to this method are the cost and maintainance of an additional machine, the motor-generator, and the liability of derangement of the lighting system by irregularity or failure in its operation. The losses in the system will be those of the motor-generator, plus the line losses, plus the transformer losses at the other end.

The same result, the supplying of direct and alternating current from the same plant, may be reached by the employment of a rotary converter instead of a motor generator. This machine has but one set of coils, takes the direct current from the generator at 110 volts and delivers alternating current at 77 volts, with very slight losses. A special static transformer will be required with the proper ratio to raise the voltage to that determined upon for the line, and standard static transformers at the other end to reduce the voltage to 110 for delivery at the lamps. The losses in such a combination will be that of the converter, very small, plus the losses in the line and two static transformers, plus the losses allowed in the line. The objection to an additional machine applies here also.

A third method was investigated as far as was possible in the time at the Board's disposal. It depends upon the employment of the same machine as the second method, but it is used in a different way. The rotary converter, instead of receiving and being driven by a direct current at 110 volts and delivering alternating current at 77 volts, may itself be driven by a prime mover, in which case it becomes an A.C.D.C. generator, giving direct current from the commutator at 110 and alternating current from the collector rings at 77 volts. Constructive conditions appear to demand that these machines shall be driven at a higher rate of speed than is possible with direct connection, and if this method be adopted, belt-driving follows as.a necessary consequence, but this is not considered a serious objection under the circumstances of the new installation. With an A. C. D. C. generator, a special static transformer will be required to step up and standard ones to step down, as in the second method. In this system, one machine is saved and losses will be about ten per cent. less than in the second method. The belt connection will require considerably more floor space than the engine type, and the only open question in this method is the effect of varying loads on the direct side upon the regulation of the alternating side, but as in the installations contemplated, the combined will rarely, if ever, occur, this question for fortification purposes becomes of secondary importance.

The use of boosters where low-tension direct current is to be transmitted over a considerable distance, is worthy of consideration; not only is this true in connection with the garrison lighting, but also in charging the larger accumulators that the new conditions require. The accumulator reserves must be increased in size and be made of sufficient capacity to supply the searchlight service for *one hour* at a non-destructive rate of discharge, which the Board experimentally determined might be taken at four times the normal rate of discharge, or to supply the lighting load of the emplacement for eight hours at normal rate. The one of these conditions which called for the larger accumulator should determine the minimum size.

Recent experience in heavy mortar firing leads to the conclusion that the largest glass jars now made will be uninjured by concussion and may be safely used. So long as glass receptacles can be obtained in the market, they are to be preferred to any others, so as to facilitate the inspection of the elements. The cells should be arranged as far as possible in single tiers vertically and in single rows horizontally. While this open arrangement is of distinct value and advantage, it is not sufficiently desirable to demand the construction of a larger room, if a smaller one already built is available.

There appeared to be no good reason for changing the system on which the switchboards had been worked out. The proposed type of plant is to consist of duplicate generators for distribution to searchlights and garrison buildings, in addition to emplacements. The two generators are supposed to be equal in capacity to the normal load, with overload capacity sufficient to take care of the variations, the second generator being provided as a mechanical reserve. The generators are under no circumstances to be operated in parallel, since each being the mechanical reserve for the other, they should not be exposed to a common danger; but, with their circuits kept separate, arrangements are proposed for working them in combination in case the demand exceeds the capacity of one, each, when so working, to take care of a distinctive part of the load. What is required, therefore, is, first—so to modify the generator switchboard that it shall permit either of the generators to supply current to several of the accumulator panels, permit one to supply certain feeders, and the other to supply certain others, while making it impossible to throw them both simultaneously on the same line; and second—to modify the accumulator panels as may be necessary to provide for such of the requirements of the garrison and searchlight services as are not met by the type previouly adopted. The restriction as to parallel working applies only to such units as are duplicated for reserves; if one of these be again divided for economy of operation, or for other reason, the two parts may be operated in parallel on a common panel.

It is proposed to provide each half of the generating plant with its own panel, carrying the measuring and indicating instruments and safety devices required for its operation, and about one-half the feeder switches. The two panels set side by side will form the generator switchboard. The bus-bars will be placed sufficiently out of alignment, so that each pair can be extended across the other panel, connecting with the distributing switches thereon, but not with any other apparatus. The feeder switches will be double-pole, double-throw to operate on either set of busses. They should be provided at the hinge with a spring holding them firmly in the neutral position, to permit of mounting them vertically instead of horizontally, which will greatly reduce the space required and simplify the connections. A single motion will throw any feeder on to either of the generators, or from one to the other. Either generator may be operated on any circuit, or on all of them, and both may be operated together, each supplying any desired circuits, but it is not possible to connect the two generators on the same circuit. A diagram showing two such panels is appended, Fig. 4.

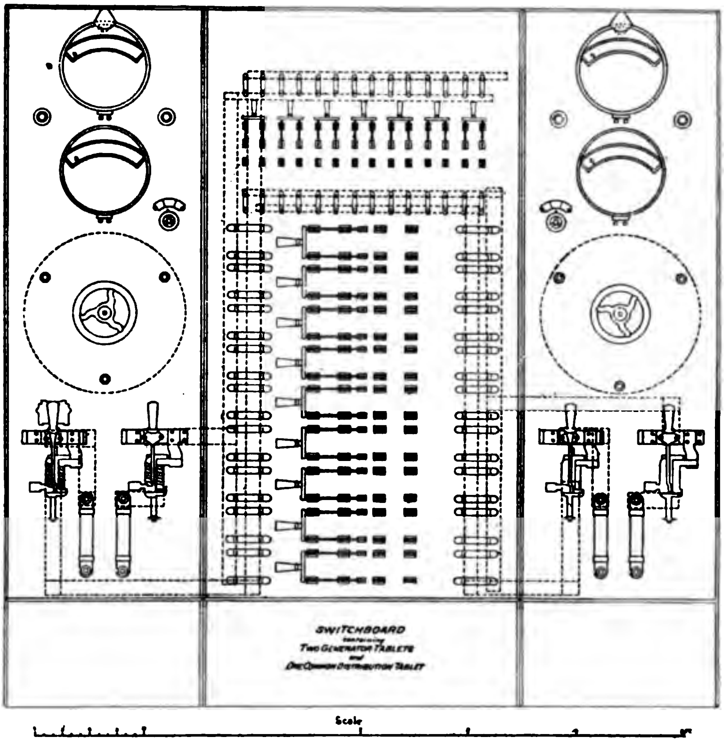

FIG. 4.

Where the number of circuits to be operated is so large that the generator panels do not afford convenient space for mounting the feeder switches, the latter may be placed on a separate distribution panel. This arrangement is also shown on the accompanying drawing, Fig. 5.

Two cases not covered by the type accumulator panel must be provided for. The first is to operate the searchlight from the generator while the accumulator is discharging. This may be done by using a double-throw switch for the searchlight circuit, connecting with the busses in one position, and the other with terminals branched from the generator leads at their entrance on to the board. By such an arrangement it will be found possible in many cases of long transmissions greatly to reduce the size of feeders using the accumulator exclusively for supplying lights, and throwing into line a portion of the large drop which occurs in charging accumulators and running searchlights. The second case will arise if the maximum garrison load is greater than the capacity of the generators and it is desired to put on the accumulator in parallel to take the peak. This case, it is thought, will seldom arise, and should be regarded as exceptional. The desired arrangement may be made by connecting the right-hand terminals 2 and 3 of the lower blade of the triple-pole switch through a single-pole switch conveniently placed. When the extra switch is open, the generator and accumulator cannot be put on busses at same time. When the extra switch is closed and the priple-pole switch thrown to the position of discharge, the generator and accumulator will be in parallel on the busses, and their joint capacity will be available, The regulation of voltages under these circumstances will require constant and expert attention, and such attention should

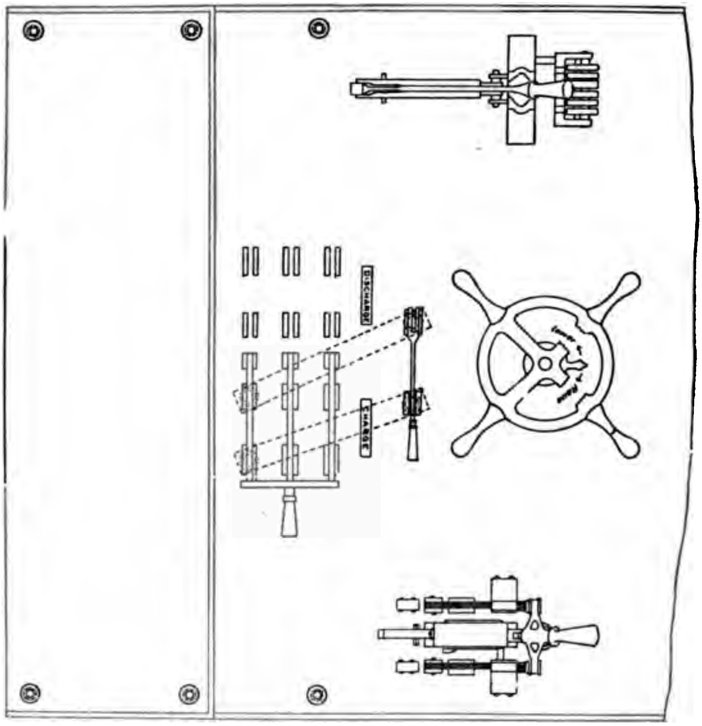

FIG. 5.

give reasonable security from the dangers which the break 2-3 in the generator leads was designed to obviate. Fig. 3 shows the proposed modifications of the type panels.

Considerable difficulty has been experienced in the use of metallic rheostats from corrosion, overheating and mechanical derangements, and the Board suggested for the consideration of local engineer officers the advisability of substituting water rheostats for metallic ones for handling large main currents. The principal requisites of a water rheostat are non-corrosive plates, preferably carbon, with closely regulated motion to control both the distance from each other and their immersion in the liquid, which should be pure water slightly acidulated. The degree of acidulation will exercise a marked influence in the resistance of the rheostat, and may be utilized with advantage in that respect. Such a rheostat should be placed where fumes can escape easily to the air and the material for its replenishment should be kept close at hand, available for instant use, with an arrangement to operate it from the usual position at the switchboard. A water rheostat well constructed and in good working order will give closer regulation than can be obtained from metallic resistances arranged in steps.

The original specifications required for all cable laid underground, conductors of soft annealed copper 98% pure, covered by an approved insulation 5/32" thick and protected by a lead sheating 1/8" thick, with a saturated fibrous covering over the lead. The insulation must be sufficient to stand a potential of 3.500 volts intermittently applied, and the resistance must not be less than 1,000 megohms per mile, when tested after twenty-four hours in sea water and after one minute's electrification. With the larger size of cable that is made necessary by the extension of the service, these resistances cannot be obtained with the specified insulations, and the new conditions can be more satisfactorily met by the use of the standards adopted in commercial practice, especially for battery purposes and search-light load, and the Board has so recommended. Aerial wires are also hereafter to conform to commercial practice rather than that required by the standard specifications.

In general, the use of aerial mains and branches for garrison lighting, in conformity with the prevailing practice of low potential current distribution in all but the largest cities, is regarded as feasible in cases where underground mains would be unduly expensive. Their exposure to rock splinters, shrapnel, rapid-fire and machine gun projectiles, is not regarded as a serious objection to their use in this service, since any severed mains, being easily accessible, can be repaired if necessary. Nor is the exposure of such lines to the view of the enemy regarded as a weighty objection, except in so far as the lines and poles might disclose the position of the power-house, the location of which would otherwise remain undetected. This difficulty is easily overcome by the use of underground conduits in the immediate vicinity of the generating station. Mains for searchlights, motors and emplacement lighting should be placed in underground conduits wherever they are not concealed from view of the enemy, or where concealed aerial lines would not be reasonably well protected by intervening obstacles from shrapnel, rock splinters and machine and rapid-fire projectiles. The depth at which the conduits should be placed to secure the desired protection depends upon the nature of the ground and the configuration of its surface, and cannot, therefore, be defined in specific terms. In general, it may be said that the depths of the conduits should be greater on ground sloping downward toward the enemy than on level ground, and greater on level ground than on a surface sloping downward toward the rear. In the horizontal area within which the heavy projectiles against a fort may be supposed to fall, the depth of the mains should, if possible, be greater than the probable vertical penetration of the heaviest projectiles, but they can safely be placed at a less depth along stretches of ground against which no heavy fire is likely to be directed. Possible interruption of garrison lighting over aerial mains by storms is believed to be less likely to occur than in commercial plants in the same locality, where mains are usually of much greater length than those required on a military reservation.

In the matter of lamps, the incandescent type is used for fortification lighting, and care is taken to secure lamps that will give a suitable distribution of light in all directions, which is not done by all lamps on the market. For the lighting of the grounds, the Quartermaster's Department has adopted and installed incandescent arc lights requiring 480 watts each.

The motors used for ammunition service are to be of the completely enclosed type, practically moisture and dust proof; to conform to the adopted voltage, and must be so arranged as to be easily and quickly detached from the hoists, permitting operation by hand in case of accident; otherwise, this part of the service is in an experimental stage. Trial is being made in some of the defenses about New York with worm gearing and spur gearing, and a special type is being made by the Elicott Machine Company of Baltimore to do similar work in Boston. Absolutely safe action in raising and, more particularly, in lowering, projectiles is very essential. These motors are supplied and installed by the Engineer Department. The Ordnance Department has contracted for motors to traverse, elevate and lower the guns, and two designs are to have a trial before a standard type is finally adopted. One is being constructed by the General Electric Company and the other by the Sprague Electric Company. Descriptions of the details of motors for this service are not taken up here, for it is understood that these will be explained and discussed in other papers.

From what precedes, it is readily seen that the conditions under which the first Board worked out its problem are materially changed. Intermittent service is replaced by continuous service owing to the introduction of garrison lighting. Inexpert and non-continous attendance, under present conditions, can no longer obtain, much as it may be desired by the Quartermaster's Department. Excessive moisture, due to condensation, is no longer to be dreaded because of the heat given by the generating plant. Simplicity of design and uniformity between the plants at the different stations, so very desirable, if not essential, since from the nature of the service army officers must be in control and changes of station from time to time seem necessary, is no longer possible, and every engineer officer in charge of fortifications must work out his own problem to suit his own local conditions, adhering to direct current throughout, if economic considerations permit, since those who are to have charge and operate the plant so desire.

Starting with the desire to light the emplacements, the application of electricity in connection with the permanent defenses has grown so rapidly and is applied for so many different purposes that it is difficult to foretell where the end will be. To the question of simple lighting is added the problem of furnishing power for the ammunition service, as a labor-saving device only, since ammunition can be supplied to the gun much more rapidly by hand than the gun service requires. Next comes the garrison service. Then we learn that motors are to be introduced for traversing, elevating and lowering the gun, machine shops to be built and operated by electricity for the use of the ordnance experts, telautograph systems to be installed by the Signal Corps for transmitting ranges and azimuths rapidly to the guns and, finally, it is learned that arrangements are to be made for firing the guns from the battery commander's station by electricity, current for all of which purposes is to be obtained from the central plant installed by the Engineer Department.

If, in the future, this advance be continued, it may not be long before even the transfer of ammunition will be made by electricity from the magazines and shot-rooms to the gun direct and the gun loaded and laid by the same means. There will then remain only the proper control in the battery commander's station to have all the work done without the aid of the enlisted man, the latter being needed only in case of a breakdown to any part of the system; in short, all that we will have to do will be to press the button, the electrical engineers and manufacturers having attended to all the rest.

# PROFESSIONAL NOTES.

## ARTILLERY MATERIAL.

### Armor, Projectiles and Military Explosives.*

BY CAPTAIN CHARLES C. JAMIESON, ORDNANCE DEPARTMENT, U. S. A.

Twenty-five miles from New York the Jersey coast ends abruptly in the highlands of Navasink, an isolated group of hills forming the highest point on the Atlantic coast south of Maine. The coast line then swings sharply to the westward, approaching by a gradual curve the narrows, seven miles from the southern point of Manhattan Island. From the highlands Sandy Hook projects due north about six miles, as if intended by nature for the location of the outer bulwark of our nation's defense at this point. The entire Hook is now controlled by the government.

The firing battery of the proving ground lies to the northeast, with the east half of the Hook for land targets, and the sea for fire at greater ranges. Here every gun that goes into the land service receives its test of five proof rounds. Every lot of powder is subjected to ballistic test, and every lot of projectiles must, before acceptance, pass two of its number chosen at random, through the best steel plates. In short, all material, and every proposed device for war receives at the hands of trained experts a thorough test.

Sandy Hook Proving Ground, N. J.

The work in which the officers and men conducting these tests are engaged is not without its danger, and premature explosions in the last ten years have resulted in the death of two officers and upwards of a score of men.

The history of the struggle between projectiles and armor which lately ended in the complete victory of the projectile probably for all time, has covered a period of forty years, beginning during our own civil war. The guns in use at that time were low power, smooth bore guns, firing spherical cast iron shot and shell at low velocities, about one-third of that obtained by modern guns. The armor of the period was simple wrought iron, but this was amply sufficient to prevent penetration, yielding only by the racking and breaking of the bolts after continued pounding. With the changes from smooth bore to rifled guns, and from spherical to elongated projectiles of cast iron with chilled points, penetration was complete. It then became necessary to provide a harder surface for the armor, and the result was the compound armor with its steel face welded by special processes to a wrought iron back. When this armor was struck by the projectiles of the period, they were broken into fragments against its face, but, due to the different elasticities of the metals in the armor, the steel tended to separate from the backing, and continued firing resulted in the breaking of the face, exposing the easily perforated wrought iron back.

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* Reprinted with permission, from *Journal of the Western Society of Engineers*, October, 1902, to which we are also indebted for the loan of the plates that illustrate the article.—ED.

Experiments in Italy, and later, in 1878-9, at the United States Naval Proving Ground, demonstrated the superiority of the all steel plate, which has passed through various stages of improvement from the first hard plate which yielded by breaking, to the soft one which yielded by punching with improved projectiles, and this in turn through the Tresidder and Harvey processes to the present Krupp plate of superb quality.

CARNEGIE-KRUPP FACE HARDENED
16' X 7½ X 11½
MIDVALE A.P. SHOT No 834 EXPLOSIVE D

The Tresidder process consisted simply in heating one of the faces of the plate to the critical temperature and then cooling it rapidly by forcing jets of ice water against this face. The Harvey process goes a step further. Plates of special composition are buried in sand, or clay, leaving one face exposed. The exposed face is covered with pulverized charcoal, weighted with fire brick, and the whole plate raised to a cherry-red color, at which temperature it is kept from four to fifteen days, depending on the thickness of the plate. This process increases the percentage of carbon on the face of the plate to a considerable depth. The plate when withdrawn from the furnace is cooled by the Tresidder process, giving an extremely hard face with a tough back, thus increasing the efficiency of the plate about twenty per cent. The Krupp process is practically an extension of the Harvey both in treatment and composition, and has so improved upon it that the six inch Krupp is nearly the equivalent of an eight inch Harvey plate.

The change from wrought iron to steel for armor, necessarily led to the abandonment of cast iron shot for those of steel, and these, later, were made of special composition and subjected to treatment under various formulæ.

Modern seacoast projectiles are divided into shot and shell, for all guns except the mortar, which uses shell only. The word "shot" originally meant a solid projectile, but in the chilled cast iron and the forged steel shot it was found that a cavity gave a stronger projectile by removing internal strains, and facilitating treatment. The primary idea was to use the shot without explosive to attack the heavy armor, following with shells against the broken plates and lighter armor. The later explosives developed, however, are sufficiently powerful to break these shot into many fragments, and they are accordingly used as shells.

The conditions of acceptance of projectiles at present are that two from a lot shall pass through the prescribed thickness of plate without cracking or material deformation, the thickness of the plate depending upon the size of the gun; those for the twelve inch being a seven-inch nickel steel plate with a striking velocity of 900 feet per second for armor-piercing shell, and a twelve inch face-hardened plate with a striking velocity of 1475 feet per second for shot. These velocities are just sufficient to insure penetration, and make the test the severest possible against this thickness of plate, as a shot which will fail at these low velocities will penetrate perfectly well without breaking if fired at a higher velocity. Mortars are short guns designed for firing at angles from forty-five to sixty-five degrees elevation, and are intended for use against the decks of ships. The armored decks of ships, which lie practically below the water line, are four and a half inches thick, and the requirement for the test of twelve inch deck-piercing shell is, accordingly, that they shall penetrate this thickness of plate at an angle of impact of sixty degrees, about that which may be expected in service. In this case the shell does not pass through in the line of impact, but swings up normal to the surface, with the result that failure most often occurs by breaking about midway back.

Simple or soft nickel steel plates may be attacked by uncapped projectiles, though against these the later form of cap-projectiles are more efficient. When penetration occurs in this plate the face of the plate rolls back around the hole until it somewhat resembles the petals of a flower; the shot, when recovered, is to the eye apparently perfect, but caliper measurements show that the shot has shortened with a corresponding increase in diameter.

The points of uncapped projectiles were often broken by the face-hardened plates, thus preventing penetration. This difficulty has been overcome by covering them with soft steel caps which are held in position by a lip forced into a groove formed around the projectile about three inches back of the point; this cap supports and assists the point of the projectile, but more particularly, upon impact it causes the whole face of the plate to dish, so that the plate is just ready to yield by the time the point of the projectile has passed through the cap. In hardened plates the skin formed by special treatment, flakes off around the hole, causing dangerous flying fragments which frequently show a fine amorphous structure, similar to the effects of frosted silver.

But, though your projectile will penetrate the plate, it is relatively harmless unless detonated by a proper explosive for a shell filler. Until within a few years black powder was the explosive universally used both in gun and projectile. With the change from low to high power guns, and from iron to forged steel projectiles, this powder failed as a shell filler, because too sensitive to shock and too weak to break the shell into sufficient fragments, failing to rupture the armor piercing shot under the most favorable conditions.

The discovery and development of a proper explosive has been a difficult problem, which also involved the parallel development of a proper detonating fuse, in itself a problem presenting many obstacles.

Two systems of attack against armor have been proposed; first, the exterior detonation of large masses of high explosives in thin walled shells of various types; second, the penetration of the plate by the projectile with detonation of the explosive in rear. This last has been the object sought by the Ordnance Department through fourteen years of continuous experimentation. In 1888 General Abbott as a member of a special board began his experiments on the strength of explosives by detonating given quantities in earth, and measuring the craters thus formed. The resulting formulæ are still accepted as standard. The work at first was necessarily slow as the field was new, and methods and implements had both to be devised.

During this period the whole field of explosives has been covered and not a few new ones have resulted from the search for one that would satisfy the difficult and contradictory conditions. Twenty-five approximately passed through the preliminary tests and were subjected to the firing tests. Among the earlier ones, was amonite in 1892, now interesting particularly because of its composition, which is almost identical with one recently presented and exhaustively tested under the name of Thorite; Emensite, in 1895, seemed so promising that a fifteen inch smooth bore gun was rifled and special projectiles made for its test. The projectiles weighed loaded 1,600 pounds and contained 500 pounds of Emensite. The gun was totally destroyed upon firing, and Emensite was adversely recommended. Experiment with fine-grained smokeless powder as a shell filler gave similar results in the twelve inch mortar, opening it up until the rear end back of the point of rupture looked like an immense tulip, and one of the steel hoops breaking at one point was straightened into a simple steel billet. Similar results were obtained from the same explosive in the seven inch howitzer, the breech of the piece being completely destroyed, while the block lodged between an eight inch rifle and its carriage.

Gun-cotton, as one of the most stable and best known explosives, was thoroughly developed, as by varying its form and the percentage of contained moisture, its sensitiveness could be largely controlled. But if enough water were used to render it sufficiently insensitive to shock against the plate, it could not be completely detonated by the fuse. As the best of the earlier explosives, however, it was officially adopted, pending further experiments.

In 1898 the requirements for a satisfactory explosive were formulated by the Department, and are as follows:

1. The explosive must be chemically stable, and not subject to deterioration in store.

2. It must be of convenient form for loading into shells, and the loading must not be attended by special danger.

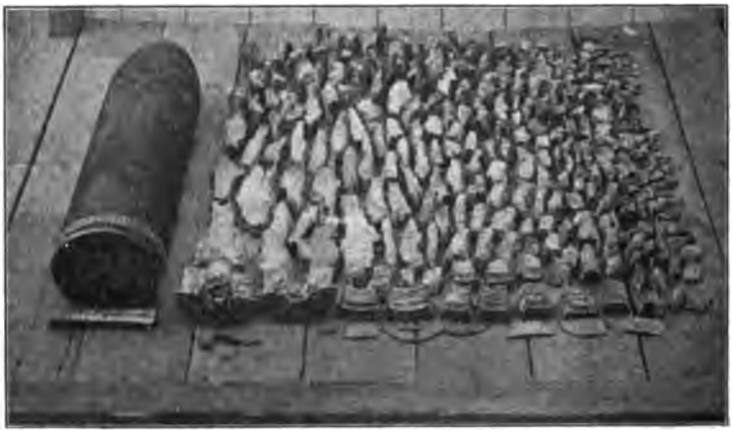
3. It must be sufficiently insensitive to withstand the shock of discharge from the gun, and the tremenduously greater shock of impact against the plate of the prescribed thickness, for example, a twelve inch plate, when fired in a twelve inch armor piercing shot.

4. Finally, it must be completely detonated after passing through the plate, by the service detonating fuse.

The tests for chemical stability and sensitiveness are now made in the laboratory Frankford Arsenal, Philadelphia, where the energy required to detonate a given quantity of explosive under constant conditions is measured in foot pounds.

Another test is for fragmentation, made by putting the shot in sand or the explosive chamber, and detonating the fuse electrically. This gives a comparison of the relative force of the explosives, and singularly enough the two most powerful are also the most insensitive to shock. The principal explosives in order of power as developed by fragmentation tests are black gun powder, Thorite, rend-rock, gun cotton, Maximite, and Explosive D. The number of fragments varies from four or five in the black powder to as many as seven thousand for Maximite when detonated in the twelve inch armor piercing shell.

A third test to which explosives are subjected, is that of firing unfused shells filled with the explosive, against plates of varying thickness to determine the maximum plate that can be penetrated without detonation due to shock, the minimum requirement being a seven inch plate for a twelve inch armor piercing shell. Of all explosives tested two only, Maximite and Explosive D, have successfully passed this requirement, and these have been successfully fired through twelve inch face-hardened plates when used in the twelve inch armor piercing shot.

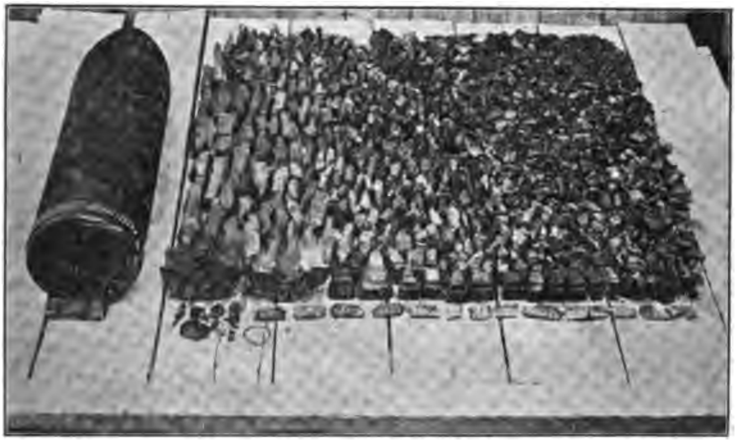


Gun Cotton Fragmentation, Twelve Inch A. P. Shell.

The plates in these tests were backed with timbers but without sand, to determine the results under the most difficult conditions. The projectiles penetrated the plates, exploding in the plates and absolutely destroying the entire structures. The explosives were accordingly adopted for use in the army seacoast rifles.

Various devices have been designed for safely firing sensitive explosives from high power guns. The Isham diaphragm shell is perhaps the best of these. The shell is cast steel, with a spindle running from point to base and diaphragms cast at intervals of five inches, which with the spindle and walls divide the interior cavity into ten rings. The pressure on the base of a long column of explosive, necessary to produce the acceleration required in a high power gun, frequently produces heat enough to detonate the explosive. The idea of the diaphragms in the Isham shell is to shorten the column of explosive and thus reduce the pressure below the danger point. This was successfully accomplished, but there are many objections to the method. Any imperfection in the casting may allow entrance of gas from the gun. The method of loading the ten compartments through holes in the exterior walls of the shell is necessarily laborious, and any portion of the exceedingly sensitive explosive used, remaining in the threads of the filling-holes, might cause detonation, and, finally, the effects produced by this shell upon the plate were not equal to those produced by the service projectile without explosive.

Competitive experiments to determine the comparative effects were made in 1899. A twelve inch Harveyized plate was so placed that it made an angle of forty-five degrees with the axis of the gun, the most favorable position for a shell of this class, for upon impact the shell detonates, and that half towards the plate is forced against it by the detonation while in normal impact its energy would be dissipated parallel to the face of the plate. The shell in this test, with its charge of 129½ pounds of explosive gelatine, was fired with a striking velocity of eighteen hundred feet per second. The plate weighed eighteen thousand pounds, so that the striking energy of the projectile weighing one thousand pounds was sufficient to give the plate a velocity of one hundred feet per second. The shell upon impact detonated, while the rear end was in front of the right half of the plate; the plate, as a result, was rotated round the middle support of the back, and sliding along on its edge fell upon its face seventeen feet from its original position. The plate itself was recovered but slightly injured, being dished about two inches in the middle and showing incipient cracks along its right edge. A second shell containing 130 pounds of explosive gelatine was fastened against the uninjured portion of the plate and detonated by the service fuse. Upon recovery after this test the plate was found to be still intact and capable of very considerable resistance.



Fragmentation of Twelve Inch A. P. Shell by Maximite.

For the test of the service projectile all conditions were, as far as possible, identical, except that a twelve inch armor-piercing shot capped, but without explosive, replaced the Isham shell. Up to this time there was no record of impact against face-hardened plate at angles greater than 21 degrees from the normal. The result was extraordinary: The projectile bit into the plate to a depth of eight inches, and carrying away the supports, moved the plate bodily back into the sand two feet, at the same time breaking it in halves; the projectile itself was broken into fragments, one remaining upon one of the pieces of the plate. Thus the destructive effect of the service shot without explosive was greater than that of the Isham shell under exceedingly favorable conditions.

The last and most interesting experiments with devices of this class were those made with Gathmann shell.

"The history of these experiments is most interesting, because

"1. The Gathmann Company clearly defined what their shells and gun would do;

"2. The Navy and War Department asserted that these results could not be produced;

"3. Congress appropriated ample funds for the experiment;

"4. Many tests and experiments were made, all sustaining the position of the experts, and the final tests were made under conditions absolutely guaranteeing completeness and fairness;

"5. The results absolutely demonstrated two facts, first, that the Gathmann gun and projectile are practically valueless as instruments of war; second, that the regular army twelve inch gun with its armor-piercing projectile charged with the latest army explosive, is the most destructive weapon ever devised."

The first experiments with this system were at the Naval Proving Ground under an appropriation made by Congress in 1896. The projectiles were tested by firing from an eight inch muzzle loading rifle, from an experimental twelve inch rifle, and by explosions against armor plates.

In the first firings from the twelve inch rifle, the shells were filled with water, and three out of four broke up in the gun. The shells were then strengthened and a round was fired with a shell loaded with 307 pounds of gun cotton and 35 grains of fulminate in the fuse. This shell exploded in the gun completely destroying it. Three subsequent rounds were fired in the eight inch rifle with shells charged and fused, but in none of these was the cotton detonated. The explosion against plates produced no material damage, and the report was against the system.

In 1898 an allotment was made by the then Secretary of War, from the war emergency fund, for experiments at the Army Proving Ground. The type of projectile presented was one having the body of less diameter than the bore of the gun, with an expansion band in front; the base which carried the fuse was a sliding piston with three radial lugs for centering it, the theory being that the gases would pass round the body of the shell to the expansion band, and the piston base acting on the saturated gun cotton would result in an equal interior pressure so the walls could be made very thin, thus carrying a large charge of explosive. Four shells of this type loaded with gun cotton were fired against a nickel steel plate ten inches thick, four feet wide and eight feet long. After the fourth shot the plate was found broken in two fragments,—a result that could have been obtained by a single round from an eight inch service rifle using an armor piercing shot with no explosive. As result of these and subsequent experiments this type of shell was abandoned and a new type devised. The second type differs but slightly from the service projectile.

The front bearing portion of the shell is placed at the center of gravity. From this point forward, by a gradual taper, the diameter is reduced from twelve to ten inches, ending in the ordinary ogive. The claim advanced was that this form of projectile greatly reduced the resistance of the air and thus made it possible to use thinner walls for the shell with increased charge of explosive.

Congress made two appropriations for the test of this type of shell; first, one of $75,000 to build an eighteen inch gun, and then one of $55,000 for the construction of targets. The gun built under this appropriation was a low power gun of large calibre, differing in no essential particular from the service gun, except in the diminished thickness of walls. The projectile for this gun, of the second type described, weighed loaded about 1,840 pounds; the service projectile for a gun of this calibre would weigh 4,400 pounds, with the result that the Gathmann projectile could be given high initial velocities with low pressures, but the velocity would fall off very rapidly as the range increased.

The targets used were similar in all respects, and actually represented a section of the latest type of battleship, but the structures themselves lacked the support of the adjacent armor plates and of the skin, frames, beams and decks that go to make the whole structure of a ship. It was concluded, however, that the targets were sufficient to make conclusive deductions as to the effect upon a battleship.

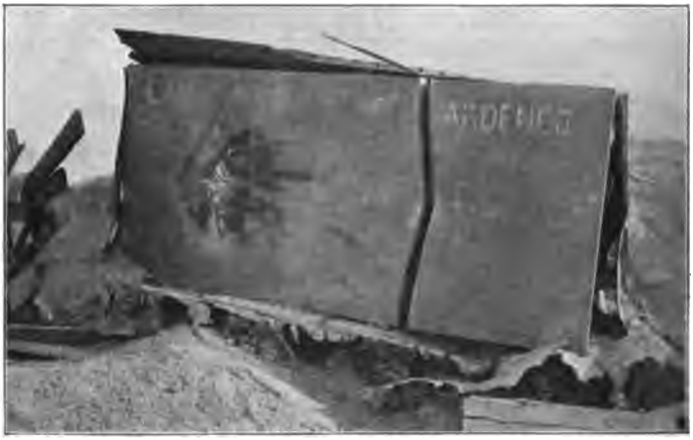
Twelve Inch Plate After First Gathmann Shot.

Round 1: A Gathmann projectile weighing 1834 pounds, including 497 pounds of wet gun cotton, struck the center of the plate with a velocity of 1650 feet per second, corresponding to a range of 2,700 yards. The energy of impact due to the mass of the projectile, was 34,610 foot tons; the gun cotton detonated on striking the plate; the plate was dished in the center one and one-half inches in the major axis and one-half inch in the minor axis and slightly flaked at the point of impact, otherwise it was uninjured. The backing and the frames behind the backing were uninjured, except for the shearing of a few rivets. Had this shot struck the belt armor of a battleship, it would not have endangered the vessel.

Round 2: A Gathmann projectile, weighing 1839 pounds, including 507 pounds of wet gun cotton, struck the right center of the plate with the same velocity and energy as before, detonating on impact. The effects on the plate and structure were similar to those of the first shot. The right hand edge was moved to the rear, and the whole structure moved thirteen inches to the right, some of the frames were slightly buckled.

It being evident that neither of these rounds would so have injured a ship as to endanger its buoyancy, it was decided to fire a third shot at point blank range in order to determine if it were possible to inflict any damage whatever upon the plate by this system of attack.

Round 3: A Gathmann projectile, weighing 1840 pounds, including a charge of 514 pounds of wet gun cotton, struck the left center of the plate with a velocity of 1970 feet per second, corresponding to point blank range. The striking energy was 49,500 foot tons As a result of this shot there was a vertical through crack eight feet distant from the point of impact extending through a row of bolt holes and through the place struck by the preceding round. In other respects the effect on the plate was as in former rounds, the backing and the skin plates behind it were slightly displaced, the bottom left hand side of the plate was shoved back four feet and the whole structure rotated to the left about thirty degrees. It is evident that had this shot struck the belt armor of a battleship it would have resulted in no injury to the interior mechanism, its armament, or its personnel, and would not have seriously menaced its buoyancy.

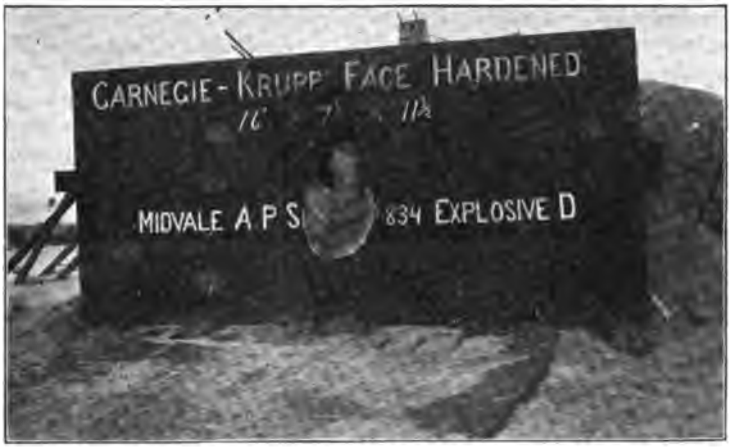


Twelve Inch Plate After Third Gathmann Shot.

TEST OF THE TWELVE INCH SERVICE RIFLE.

Round 1: A twelve inch armor-piercing shot weighing 1001 pounds and 7 ounces, including 19 pounds and 7 ounces of Explosive D., struck the center of the target with a velocity of 1800 feet, corresponding to a range of 4400 yards, with 22,500 foot tons striking energy. This shot penetrated the plate and detonated in rear. The backing, the skin plate, the frames, and cofferdam plates were completely demolished in line of impact; the crater formed in the sand butt in rear of the structure measured 15 by 6½ feet. Pieces of the plate and projectile passed through the structure, through the butt, and were recovered from 150 to 200 feet in rear. It is evident that this shot would have seriously affected the structure and armament of a ship.

**Round 2:** A twelve inch armor-piercing shot weighing 1006 pounds with twenty-three pounds of Maximite, struck the right center with the same velocity and energy as before, detonating in the plate and completely wrecking the right hand hand portion; it demolished the frames behind the armor and the plates of the cofferdam.

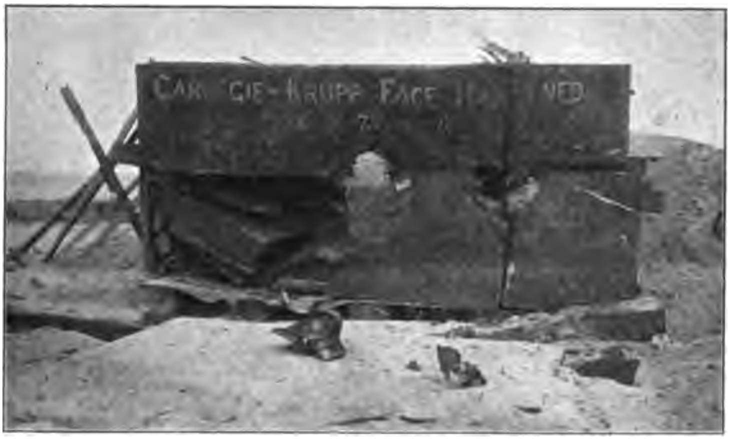


Twelve Inch Plate After First Service Shot.

Rear View of Twelve Inch Plate After Second Service Shot.

**Round 3:** A twelve inch armor-piercing shell weighing 1,045 pounds, including sixty pounds of Explosive D., struck the lower left hand corner with a velocity of 2,073 feet per second, corresponding to a range of 1,880 yards; the energy was 31,100 foot tons. The shell penetrated and detonated in the plate; the plate was completely wrecked, and the backing, frames, beams, and cofferdam plates of the structure demolished. An opening four feet wide by eight feet long was made through the plate; one large fragment about two by two and a half feet was hurled through the target and through the butt, being recovered 135 feet in the rear of it.

The Act of Congress required that at least ten shot should be fired at the structure from the army rifle, but the annihilation of the structure by three shots made it impracticable. It may be said in this connection that the destructive effect of the twelve inch army rifle surpasses anything hitherto obtained from any gun so far as records show.



Front View of Twelve Inch Plate After Third Service Shot.

The report of the Board conducting these experiments bore this indorsement from the Chief of Ordnance:

"Respectfully submitted to the Honorable, the Secretary of War: As this test has afforded the first occasion for demonstration to others than the officers of the Ordnance Department who have been concerned in their development, of the power of the explosives used with the twelve inch army rifle, it appears pertinent to invite attention to the cardinal points of the achievement, namely: The development of an explosive sufficiently insensitive to be fired with safety from high power guns with full charges.

"Sufficiently insensitive to withstand the shock of impact against heavy armor plates.

"Sufficiently powerful to produce as great a shattering effect as desired.

"The development of a detonating fuse which is capable of being fired with safety from high power guns with full charges, which is sufficiently powerful to realize the full force of the explosive, which, set in action by the impact of the projectile, produces detonation after sufficient delay to insure penetration and the greatest destructive effect both upon and behind the plate."

## New Designations for Smokeless Powders and Explosives, Austro-Hungary.

*Smokeless Powders.*—Of late some new smokeless powders have been issued for the Austro-Hungarian service, principally tubular powders (*Rörchenpulver*) also called *macaroni* powders, and new designations for them have been recently adopted. The following table gives the list of powders in use, with the former and new names.

It may be useful to give first, however, a few general remarks on the table.

Each powder is characterised by its form, by a fraction and by a date of adoption. The different forms are the following:

Discs or wafers (*Scheibchenpulver*);
Cylinders or cords (*Cylinderpulver*);
Plates (*Plättchenpulver*);
Tubes or *macaroni* (*Rörchenpulver*):
Bands or ribbons (*Bandpulver*).

The numerator and denominator of the characteristic fraction represent the smallest and largest exterior dimensions of the grain in millimetres. Thus in the lamellar or plate powders, the numerator represents the height of the grain, and the denominator, the length of the side; in the macaroni powders, the numerator gives the exterior diameter of the tube, and the denominator, the length of the tube.

| FORMER DESIGNATIONS. | NEW DESIGNATIONS. | REMARKS. |
|---|---|---|
| Powders for small arms [Nitrocellulose (Schiesswollpulver)]. | | |
| Rifle powder, M.92 | Disc powder, $^{0.5}/_{2}$ mm. | |
| .................... | Disc powder, $^{0.1}/_{1}$ mm., M. 97c. | For magazine pistols, (*Repetirpistolen*). |
| Blank cartridge rifle powder........ | Blank-cartridge disc powder, $^{0.2}/_{2}$ mm. | |
| .................... | Disc sporting powder, No. II, (*Jagd-* und *Scheibenpulver*). | For revolver cartridges, M. 98. |
| Cannon powder [Nitrocellulose and nitroglycerine (Sprengölpulver)]. | | |
| 2 mm. M. 93........... | Cylinder powder, $^{1}/_{4}$ mm. M. 93. | For field guns, M. $^{75}/_{90}$. |
| 2 mm. M. 95........... | Plate powder, $^{1}/_{2}$ mm., M. 93. | For siege and position artillery. |
| 3 mm. M. 95........... | Plate powder, $^{1}/_{3}$ mm., M. 93. | For siege and position artillery. |
| 5 mm. M. 95........... | Plate powder, $^{2}/_{4}$ mm., M. 93. | For siege and position artillery. |
| 7 mm. M. 95........... | Plate powder, $^{2}/_{6}$ mm., M. 93. | For siege and position artillery. |
| .................... | Plate powder, $^{2}/_{8}$ mm., M. 93. | For siege and position artillery. |
| 10 mm. M. 95.......... | Plate powder, $^{3}/_{8}$ mm., M. 93. | For mortars, cal. 24 cm., M. 98. |
| .................... | Plate powder, $^{2}/_{4}$ mm., M. 97b. | For 9 cm. steel shells, M. 95. |
| .................... | Ribbon powder, $^{5}/_{310}$ mm., M. 97. | For shells M. 98 of the 7 cm. guns, L/42. |
| .................... | Ribbon powder, $^{8}/_{340}$ mm., M. 97. | For shrapnel and canister M.98 of the 7 cm. guns L/42. |
| .................... | Macaroni powder, $^{15}/_{400}$ mm., M. 97. | For blank cartridges, 15 cm. M. 97. |

| FORMER DESIGNATIONS. | NEW DESIGNATIONS. | REMARKS. |
|---|---|---|
| .......................... | Macaroni powder, $^{15}/_{570}$ mm., M. 97. | For 12 cm. cartridges. |
| .......................... | Macaroni powder, $^{15}/_{710}$ mm., M. 97. | For 12 cm. cartridges, L/40. |
| .......................... | Macaroni powder, $^{15}/_{720}$ mm., M. 97. | For 15 cm. naval guns. |
| .......................... | Macaroni powder, $^{21}/_{555}$ mm., M. 97a. | For 28 cm. coast guns, L/35. |
| .......................... | Macaroni powder, $^{21}/_{622}$ mm., M. 97a. | For 30.5 cm. coast guns, L/40. |
| .......................... | Macaroni powder, $^{21}/_{700}$ mm., M. 97a. | For 24 cm. coast guns. |

*Explosives.*—Ordinary projectiles are charged with black powder (*Ammonpulver M.* 90 *and M.* 96 $^{15}/_{85}$ *mm.*, ammonium nitrate, charcoal, sulphur, etc.).

The high explosives are the following:

Ordinary dynamite, Nos. 0, I., II., II.a, II.b, and III.;
Heavy friable dynamite, Nos. I. and II.;
Dynammon[*];
Wetterdynammon;
Ecrasite (nitrocresylate of ammonia);
Nitrocellulose (designated by the strength of nitrification.)

—*Revue d'Artillerie*, September 1902.

### New Explosives and Powders in Italy.

Captain Anton Cascino of the Italian artillery, instructor at the military school at Modena, has written a book under the title of "*Il tiro, gli esplosivi e le armi*", which, intended as a text-book for use in this school, and particularly on explosives which have been adopted in the Italian service, gives some information well worth noticing. Some extracts are here given:

#### PERTITE.

The picric acid compound adopted in Italy for explosive shell has received the name Pertite. Pertite is produced by the action of concentrated nitro-sulphuric acid on phenol ($C_6H_5.OH$):

$$C_6H_5.OH + 3\,(HONO_2) = C_6H_2(NO_2)^3.OH + 3\,H_2O;$$

the free water being absorbed by the sulphuric acid.

*Properties.*—Pertite crystallises in needles of a bright yellow color, and has a very bitter taste. It is soluble in cold water in the proportion of 1 : 160, and colors the latter an intense yellow; it is yet more soluble in warm water and most soluble in ether and benzine. It readily attacks metals, forming picrates, and melts at 122.5, which is one of its most marked characteristics for purity. Even at ordinary temperatures vapors are given off, only in the smallest amount, it is true, which increase with a rise of temperature. Small quantities of pertite can, with great care, be warmed up to 200° without dangerous results. It undergoes thereby a slight decomposition and becomes black;

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[*] *L'Armeeblatt*, No. 5 of 1902, states that the field howitzers in practice firing fired projectiles charged with a rather powerful explosive, in regard to which secrecy has been so well maintained, that even its name is not well known. It was called at first *dynammon*, while at present its name might be *ammonal*. The new product may have a picric acid base like ecrasite.

brought suddenly up to 300°, it explodes violently. It is generally slightly poisonous. The vapors and dust of pertite cause violent sneezing, and when inhaled for some length of time, prove injurious to the health.

Its physical state (crystalline) is also an advantage as regards stability; relatively large variations in temperature cannot affect it in this state, so that it is not liable to freeze like dynamite and similar preparations. Pertite does not readily absorb moisture. It is stated that when immersed in water it does not lose its explosive properties.

Pertite has an explosive force which is equal to at least that of an equal weight of charge of nitro-cellulose; in view, however, of the great density which is obtained by compressing the latter in projectiles, the greater effect of equal masses compared to pertite is easily understood. As a matter of fact, the density of fused pertite is 1.70, while that of nitro-cellulose in cakes is 1.10 to 1.15.

The equation according to which the reaction of the picric acids in explosion takes place, is not yet known. If the following is taken

$$2(C_6H_2(NO_2)^3.HO) = 3CO_2 + 8CO + C + 6H + 6N,$$

there results from the laws of thermodynamics that every kg. of pertite produces 750 calories, whereby a volume of gas is developed which, reduced to 0° and a pressure of 1 atmosphere, is equal to 829 l. with a theoretical pressure of about 11,000 atmospheres, if the explosion ensues according to that for a unit volume, This data is to be confirmed, however, by experiments.

Pertite when exploded causes white (?) clouds of smoke. The explosion, however, is incomplete, as thick yellow fumes develop which are caused by the volatization of a part of the pertite; the ground over which this takes place appears to have been painted yellow.

In order to test the insensibility of pertite charges to blows or shock an experiment was made in which four charges were fastened to a table and fired at with a 6.5 mm. magazine rifle M.91 at a distance of 25 m. Four shots struck and shattered the charges without causing any explosion of the pertite or setting it on fire. Other experiments go to show that of all known explosive substances, black powder not excepted, pertite is least sensitive to blows or shocks.

Free in the open air pertite burns quietly, without exploding, if not more than 8 to 10 kg. are ignited, as otherwise the great heat developed and the increasing effect of the gases cause an explosion. The pertite charge without fuse (for reasons of safety) can be considered as an entirely inert substance.

Enclosed in hollow projectiles with walls offering some resistance, pertite explodes even from the mere effect of some energetic impulse (the explosion of quick-burning powder); the use of a 2 gm. explosive capsule, however, and the insertion of a detonating charge of pulverized picric acid in a steel envelope has been found more suitable.

*Use.*—Pertite can be used as well in the conglomerate form (*agglomerazione*), obtained by melting and then moulding it, as also in the pulverized and compressed form. In such cases, the density varies between 1.70 for the fused pertite and 1.3 to 1.5 for the compressed. The rapidity of combustion also depends on the form in which it is used, the former exploding less rapidly than the latter, from which it follows that the work performed in the latter case is more wholly confined to the moment of explosion. This property of picric acid is made use of in Italy by inserting pulverized picric acid as a detonator between the moulded mass and the 2 gm. fuse capsule. In explosive shell, pertite is melted and the poured in, or else pulverized and then compressed. The first method is the one most commonly adopted.

—*Schweizreische Militärische Blätter*, October, 1902.

### Field Guns at the Instant of Firing.

No description could give one such a clear idea of the fundamental importance of having a carriage which absolutely does not move due to recoil, as the comparison "by sight" does of the manner in which the various kinds of field gun carriages behave when the piece is fired; that is, a field gun carriage of former construction with rigid trail-spade, a gun with elastic trail-spade and one with recoil on the carriage. The illustrated review, *Ueberall*, has published three illustrations representing these three types of guns at the moment of firing; that is, at the instant when the violent shock of recoil is manifested. These photographs are herewith reproduced.

Fig. 1 shows a field gun with rigid trail-spade. The latter is firmly imbedded in the ground, and as the piece is on hard ground, the spade holds the carriage when the shot is fired. This is fully shown in the photograph. However, the force of recoil necessarily must act in some manner, and its effect is plainly seen on the piece and the forward part of the carriage; the latter rears, that is to say, it rises from the ground to fall back afterwards more or less exactly in its initial position. The piece must be laid again after each round which takes more or less time depending on the greater or less amount of loss of aim. The rapidity of fire is diminished accordingly.

The field gun with elastic trail-spade, shown in Fig. 2, constitutes a decided improvement on the preceding carriage. Here also the piece is shown at the moment of firing, The spade, at first inclined to the rear, biting into the earth, has rotated about a hinge-bolt, and the trail has recoiled a proportionate distance. Simultaneously the spade has compressed a column of springs placed between the cheeks of the carriage. The expansion of these springs then returns the piece to its first position. The smoothness and ease of working of the elastic trail-spade is shown by the position of the 3rd cannoneer who can place himself immediately behind the trail, without fear of being hurt by the recoil. It is no longer a question here of a "jump" of the piece. The movement is shown in the photograph by the blurred appearance of the wheels and carriage.

Finally, Fig. 3 shows a field gun recoiling on the carriage at the moment of firing.

The gunner is seen seated on a seat attached to the trail, from which position he manipulates the sighting apparatus, while the gun recoils. The gun passes by his right shoulder which is protected by a standard fixed to the cradle.

The lower carriage rests absolutely immovable so that the two other cannoneers can remain on their places immediately near the gun and behind the trail as shown in the figure. This permits the repointing and the reloading of the piece to be accomplished while the gun is returning "in battery". The interval between two rounds is determined, then, solely by the time necessary for recoil and the return into battery of the piece alone.

—*Internationale Revue über die gesammten Armeen und Flotten, Supplement* 45,
December, 1902.

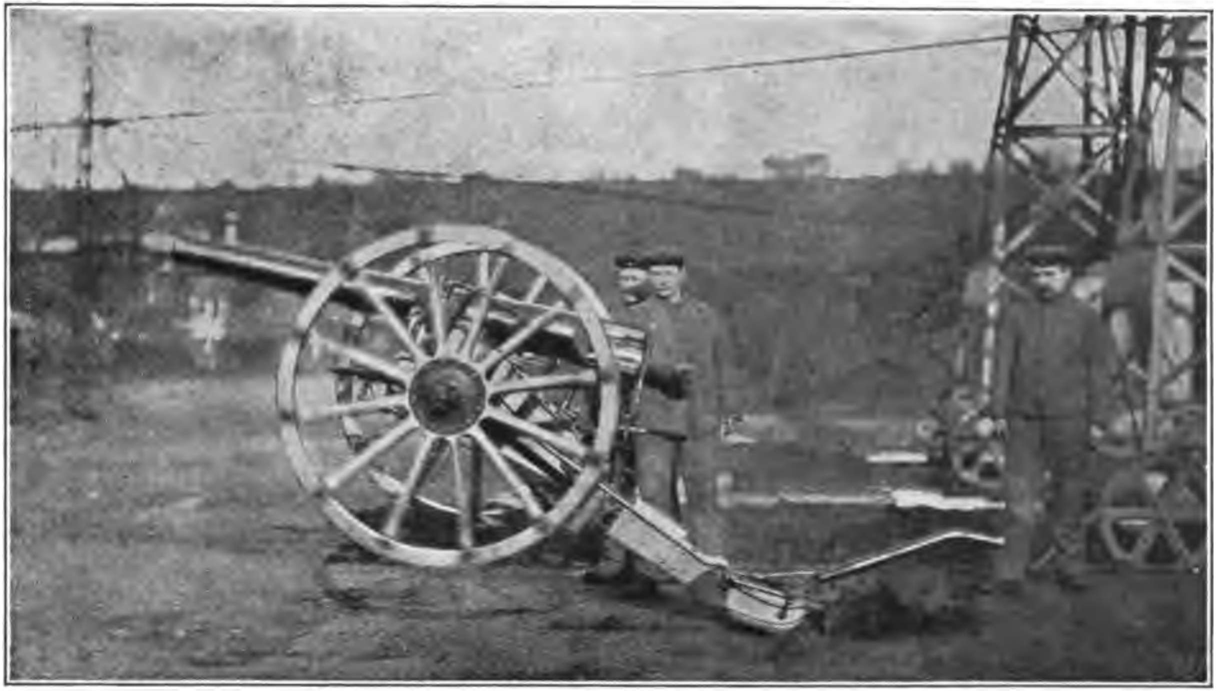

Fig. 1. — Field gun carriage with rigid spade, at instant of firing.

Reproduced from *Internationale Revue.*

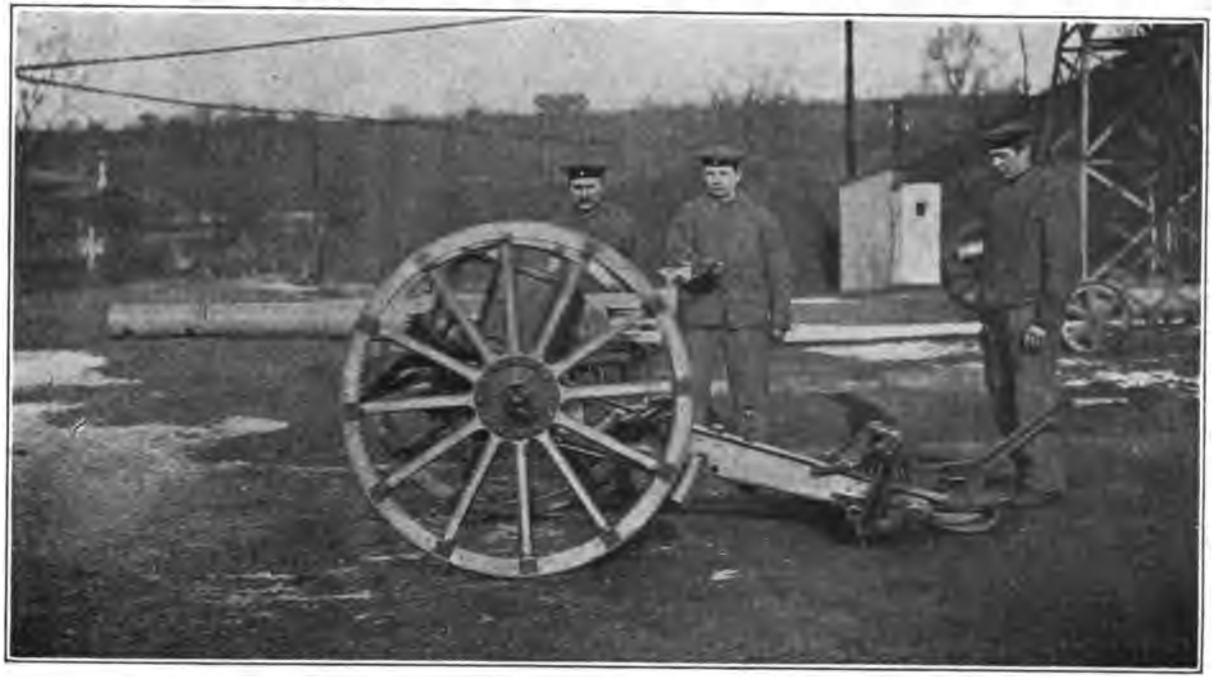

Fig. 2. — Field gun carriage with elastic spade, at instant of firing.

Reproduced from *Internationale Revue.*

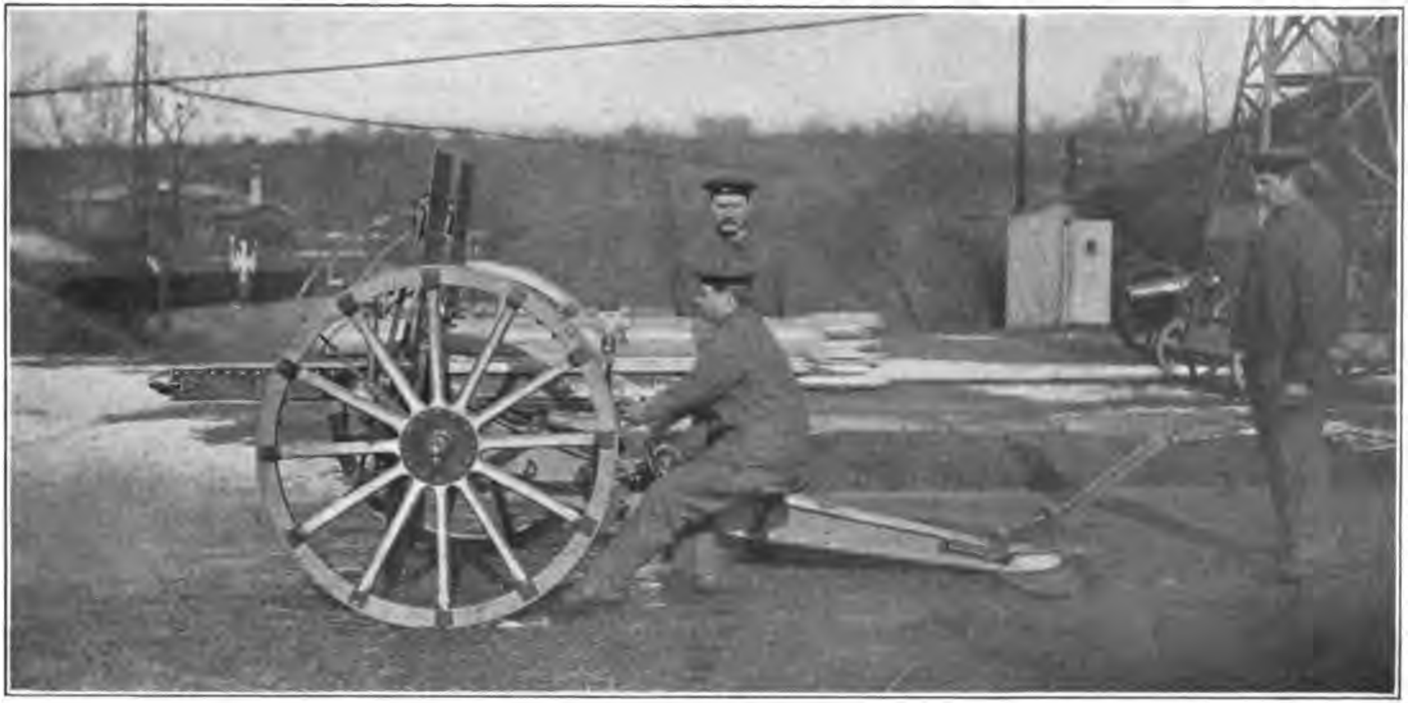

Fig. 3. — Field gun with recoil on carriage, at instant of firing.

Reproduced from *Internationale Revue.*

# DRILL REGULATIONS, MANEUVERS AND PRACTICE.

## Manual for the 10-inch and 12-inch B. L. Rifles.

ARRANGED BY CAPTAIN S. C. VESTAL, ARTILLERY CORPS.

The manual is arranged for the 10-inch B. L. rifle on disappearing carriage, model 1896, in an emplacement provided with ammunition lifts.

Parts in *italics* are additional, and apply only to the 10-inch B. L. rifle on disappearing carriage, model 1894, in an emplacement provided with ammunition lifts. Parts in **heavy face type** are additional, and apply only to the 12-inch B. L. rifle on disappearing carriage in an emplacement provided with ammunition lifts. Parts enclosed by vertical lines || are explanatory or are of occasional use only. Effort has been made to arrange the drill in natural sequence, and, as far as practicable, to assign definitely to every man his particular duties.

### POSTS.

Gun commander, sergeant, two yards in rear of breech, facing it.

Gunner, corporal, or private duly qualified, on sighting platform.

Breech detail, 4 privates, Nos. 1, 2, 3 and 4, in line, immediately in rear of breech, facing it, and in the following order from left to right; Nos. 4, 2, 1 and 3.

Elevating detail, 2 privates, at elevating hand-wheels, facing them; No. 5 on right, No. 6 on left.

Traversing detail, 2 privates, Nos. 7 and 8, at traversing cranks, in front of them, facing from parapet; No. 7 on right, No. 8 on left.

Charge detail, 4 privates, Nos. 9, 10, 11 and 12. Nos. 9 and 10 opposite middle of tripping bars, one yard outside of carriage, facing it, No. 9 on right, No. 10 on left; Nos. 11 and 12 opposite muzzle in loading position, facing gun, and in line with Nos. 9 and 10, respectively.

Supernumeraries, 2 (4) privates, Nos. 13 and 14, near parapet facing from it, outside of Nos. 11 and 12. **Nos. 15 and 16, near parapet, facing it, outside of Nos. 13 and 14.**

### SERVICE OF AMMUNITION.

The ammunition detail consists of an ammunition sergeant and 8 (10) privates.

The ammunition sergeant inspects cartridge room, shell room, ammunition lifts, shell-tongs, and trolleys; exercises general supervision over supply of ammunition; and, assisted by one private, fuses shell, when required.

The cartridge detail, 2 privates, uncases cartridges, puts empty cases to one side, and places sections of cartridges on shelves of truck.

The shell room detail, 2 (4) privates, operates trolley and shell-tongs, and places shot on truck.

The lift detail, 2 privates, operates lift, runs empty truck off and full truck on lift.

The platform detail, 1 private, opens and shuts doors to lift, operates chock of lift and runs empty truck on lift.

### EQUIPMENTS AND STORES.

One range scale, 1 difference chart, 1 sight, 1 electric firing machine, 3 sleeves, 2 buckets containing oil and hand sponge, 1 bore sponge, 1 chamber sponge, 1 rammer, 1 prop, 1 primer pouch, 1 primer key and wire, 1 lanyard, 1 loading tray, 2 traversing cranks, 2 tripping bars, 1 funnel, 1 oil measure containing oil, and 1 wrench.

The detachment being in two ranks in rear of the gun emplacement facing the piece, to prepare for drill (or action).

The gun commander commands: 1. No.—, PREPARE FOR DRILL (or ACTION). 2. No.—, EXAMINE GUN.

### 1. No.—, PREPARE FOR DRILL (or ACTION).

The gun commander carries out range scale and difference chart and places them on shelf or table near dial telegraph or telephone.

The ammunition sergeant conducts his detail to the magazine, sees that each member of it is informed as to his duties, inspects the magazine, lifts, etc., and prepares to supply ammunition. He sees that all projectiles sent to the gun are carefully cleaned.

The special details go to their stations, examine the instruments to which they are assigned, and make necessary adjustments.

The reserve takes station wherever directed by the gun commander.

The gunner forms the gun detachment, and commands: CALL OFF. Each number of the detachment in succession, beginning with No. 1, calls distinctly, the number to which he has been assigned.

The gunner then commands: PROCURE STORES.

The gunner carries out sight and places it on sight standard.

Nos. 1, 2 and 3, assist one another in putting on the sleeves. No. 1 carries out lanyard and prop and firing machine, if used, and places them convenient to the breech, on the side opposite the ammunition lift. No. 2 equips himself with primer wire and carries out loading tray, and places it convenient to the breech. No. 3 carries out two buckets containing oil and hand sponge and places them convenient to the breech.

No. 4 carries out rammer.

No. 5 carries out bore sponge, No. 6, chamber sponge, and place them on prop.

*Nos. 5 and 6 carry out retraction ropes and place them on loading platforms out of the way.*

Nos. 7 and 8 carry out traversing cranks and place them on worm shafts on their respective sides. No. 8 attends to traverse crank clamp.

No. 9 carries out tripping bar and places it on hooks on right side of chassis; also funnel and oil measure containing oil for filling cylinders and places them convenient to his post out of the way.

No. 10 carries out tripping bar and places it on hooks on left side of chassis; also wrench for filling plugs and places it convenient to his post.

No. 14 equips himself with primer pouch and primer key.

### 2. No.—, EXAMINE GUN.

Nos. 1 and 2 remove breech cover, and Nos. 11 and 12 muzzle cover; fold them and place them out of the way.

Nos. 1 and 2 open breech, No. 1 operating rotating crank, and No. 2 translating roller. No. 2 clears vent.

> When necessary to use the punch, the gimlet, or the reamer to clear the vent, it should be introduced from the mushroom head end of the vent.

The gunner examines sight, inspects bore, chamber, breech box, breech block, and breech mechanism. If necessary, Nos. 1, 2 and 3 clean same. Nos. 1 and 2 then close breech.

Nos. 9 and 10 remove filling plugs; if necessary, fill cylinders and replace plugs. No. 11 passes funnel and oil measure up to No. 9 if called for, and replaces them.

The filling plugs of both recoil cylinders should be removed if any filling is to be done, to avoid the formation of an air cushion.

The gun commander tests the elevating and traversing gear, the level of the traverse circle, and the telephone and telautograph.

### TO LOAD AND FIRE.

The gun commander commands:

1. No.—, LOAD. 2. No.—, PREPARE TO TRIP. 3. No.—, TRIP. 4. No.—, FIRE.

### 1. No.—, LOAD.

No. 1 disengages one of the wires of the firing machine, if used. Nos. 1 and 2 open breech. No. 2 clears vent, removes pressure plug, hands it to gun commander, and puts in new plug for next round. No. 14 removes old primer, and after the vent is cleared, inserts new primer and screws it well home, while the breech is yet open.*

When pressure plugs are used, the gas check and screw threads should be covered with lubricant.

If necessary to clean bore and chamber, No. 4 brings up bore sponge, and assisted by Nos. 1 and 2, sponges bore; while the sponge is being withdrawn by Nos. 1 and 2, No. 4 brings up chamber sponge, and exchanges it with No. 1 for bore sponge, replaces bore sponge, and, if the piece is to be loaded, brings up rammer and exchanges it for chamber sponge, replaces chamber sponge, and returns to rammer. Neither sponge need be used with smokeless powder. With other powders the chamber sponge, dampened, not saturated, should be forced through the powder chamber after each discharge.

No. 3 washes breech box and breech block with hand sponge soaked with oil, cleaning gas check, gas check seat, mushroom head, block threads, and wipes surfaces washed.

No. 2 seats loading tray. Nos. 11, 12 and 13, bring up truck, place it in position at breech, and chock wheels. No. 4 brings up rammer.

Nos. 1, 2, 3, 4, 9, 10, 11 and 12, (15 and 16) take hold of rammer handles on their respective sides with hands nearest rammer, Nos. 1 and 2 nearest the breech. No. 1 places rammer head against base of projectile. At the command: RAM, given by No. 2, the projectile is forced into the chamber until its base is about thirty inches beyond loading tray. No. 13 removes truck from breech.

No. 2 commands: HOME RAM. At the first command, the numbers at the rammer take a firm hold; at the second, all working together, send the projectile home with all force possible. All quit the rammer except Nos. 1 and 2, who withdraw it. No. 2 quits rammer, receives section of cartridge from No. 9, and inserts it in the breech. Nos. 1 and 2 place head of rammer against section, push it home without unnecessary force, and withdraw rammer. No.

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* Much time and trouble would be saved, and danger avoided, if every gun equipped for firing with electric primers of the type now in use, were provided with two double binding posts to attach the connecting wires to the primer wires. The screw heads and the bodies of the posts should be covered with insulation. Between rounds the binding posts could be left on the ends of the connecting wires ready to be attached, in the twinkling of an eye, to the primer wires.

1 passes it to No. 4, who replaces it. No. 2 receives rear section from No. 10, inserts it in breech, and pushes it forward by hand so that its base barely clears gas check seat. Nos. 11, 12 and 13, return truck to lift.

No. 2 removes loading tray. Nos. 1 and 2 close breech. No. 1 passes lanyard hook, or wires, to No 2. and then coils them in such a way that, as the gun runs up to the firing position, they will run freely. No. 2 hooks lanyard in eye of primer, or connects wires.

2. No.—, PREPARE TO TRIP.

Nos. 9 and 10, assisted by 11 and 12, engage the tripping bars against the lever end of the pawls.

3. No.—, TRIP.

The pawls are released by a quick, hard jerk on each bar, and should be held released until the ratchets have passed below their upper ends. Nos. 9 and 10 replace tripping bars.

If the gun fails to run fully up to the firing position, Nos. 9 and 10, assisted by Nos. 11 and 12, force it up the remaining distance, using the tripping bars in connection with the fulcrums on the forward ends of the chassis rails and the ratchets under the outer clips of the top carriage.

Meanwhile, the gun has been aimed or laid approximately during the loading by the gun commander and gunner in Cases II and III, the gun commander giving the elevation, the gunner, the azimuth; by the gunner alone in Case I. When aimed or laid accurately, the gunner commands: READY. All step clear of the recoil. No. 1 tautens the lanyard, or connects wire with firing machine.

4. No.—, FIRE.

No. 1 gives the lanyard a strong, quick pull, or presses steadily down upon the handle of the firing machine, until the lower end of the bar strikes.

After firing, the gun commander immediately commands: LOAD. The men quickly resume their posts and duties.

### TO BRING THE GUN FROM THE FIRING TO THE LOADING POSITION.

The gun commander commands: 1. No.—, MAN THE RETRACTION GEAR 2. No.—, HEAVE. 3. No.—, HALT.

1. No.—, MAN THE RETRACTION GEAR.

Nos. 11 and 12 go to the traversing cranks. No. 11 raises pawl. Nos. 3, 4, 5 and 6 pull out the retraction chains on their respective sides. Nos. 1 and 2 mount chassis and receive ends of chains (*or ropes*) from Nos. 3 and 4, and attach them to hooks on gun levers. No. 11 takes in the slack. Nos. 9, 10, 11 and 12 (15 and 16), assisted by 7 and 8 if necessary, man retraction cranks, Nos. 9 and 10 on the outside.

2. No.—, HEAVE.

The men at the cranks heave the gun back to the loading position.

3. No.—, HALT.

No. 11 lets out enough slack to enable Nos. 1 and 2 to take the ends of the chain off lever hooks, and all resume their posts and duties.

### TO CEASE FIRING.

The gun commander commands: No.—, CEASE FIRING. No. 2 unhooks lanyard or No. 1 disconnects one wire at firing machine.

### TO REPLACE STORES AND FORM DETACHMENT.

The gun commander commands: 1. No.—, REPLACE STORES. 2. No.—, FORM DETACHMENT.

1. No.—, REPLACE STORES.

Each number replaces the stores that he provided. The gun, magazine, and storerooms are properly secured.

2. No.—, FORM DETACHMENT.

The detachment is formed in proper order in rear of the gun emplacement.

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### Gunnery.

Captain E. G. Waymouth, Royal Artillery, has recently returned from service at Hong Kong and makes the following statement (over his signature):

Guns were 4.7-inch.

Automatic sights.

Target 60 feet long by 6 feet high.

Target towed 12 knots, with winding-up arrangements that can increase the speed to 20 knots, average 17 knots.

Zigzag course steered, making the range vary between 1160 yards and 3000 yards.

Height of battery 78 feet.

Pedestal mounts.

Watkins (patent) sight, Government monopoly.

2 guns, 25 shots each gun, time 2 m. 5 s.

50 shots, about 40 hits.

## WARSHIPS AND TORPEDO BOATS.

### Operations of French Submarines.

Considerable interest attaches itself to the various exercises in attacks which have been practiced during 1902 by French submarine boats.

The French are the principal exponents of this type of naval element and have devoted great attention to it, having by far the greatest number of submarine boats, and in consequence greater experience. France relies upon this type of craft as a strong element of coast or harbor defense, and while the result of the attack of the *Gustave Zédé* may appear to furnish sufficient ground to justify the faith held in the submarine, nothing but practical experience in war can definitely decide its absolute value.

England, Germany, and Russia are developing the submarine, but very little information is obtainable concerning the progress in the two last-named countries.

At Cherbourg the submarines *Morse* and *Algerien* and the submersible *Sirene* attacked the turret ship *Bouvines* while the latter was riding to a buoy in the harbor. The boats left the harbor under water and the *Bouvines* was to repel their attacks by gun fire as they rose to the surface to fire their torpedoes. The *Algerien* was put out of action. The other two boats fired their torpedoes, fitted with exercise heads, before they were observed on board the *Bouvines*.

Similar experiments were made by the *Norval*, *Morse*, and *François* against the torpedo gunboat *Cassini*, as the latter, forewarned, was entering the port. The *Cassini* was hit by torpedoes from all three of the boats. The *François*, however, remained so long above water before discharging her torpedo it was adjudged that in actual combat she would have been destroyed.

The *Amiral Trehouart* was likewise successfully attacked as she was entering the harbor.

On January 7, 1902, there was a general attacking drill with the *Morse*, *Francois*, *Narval*, *Espadon*, and *Triton* against the *Bouvines*, *Amiral Trehouart*, and *Cassini*.

The first two guarded the west entrance to Cherbourg, the other three the east entrance, with the *François* north of the breakwater. The *Bouvines* and *Cassini* entered from the westward. The *Bouvines* was hit by the *Morse* at 100 meters, but the *Cassini* escaped the *Narval* on account of her speed. She was, however, hit by the *François*.

The *Amiral Trehouart* destroyed the *Triton* by gun fire, but was later hit by the *Espadon*. The *Triton* had been obliged to rise to avoid a fishing boat, and thus exposed herself to the fire of the *Amiral Trehouart*.

The French papers lay great stress on the fact that these drills took place during the stormy winter season and therefore speaks much for the seaworthiness of the boats.

Their tactics seem to be attacks against ships lying still in the water, or to wait for ships moving in narrow passages.

Perhaps the most interesting attack was that of the *Gustave Zédé* off Ajaccio during the naval maneuvers of 1901.

The *Zédé* left Toulon for Ajaccio in tow of a Government tug. Upon nearing Ajaccio the tug was dismissed, the *Zédé* lying on the surface of the water to wait for the enemy. Upon two cruisers leaving their anchorage the *Zédé* sank, but later rose to the surface, and seeing the battleships still at anchor, and having in the meantime approached the battleships, took bearings for an attack. When the battleships began to move the *Zédé* again sank, and as the *Charles Martel* passed over the submarine a torpedo was fired into the *Martel*. In rising, after having successfully attacked the *Martel*, the *Zédé* was nearly run down by the *Jaureguiberry*.

Accounts vary as to Ajaccio being considered an impregnable port, and consequently of ships at anchor there being relieved of the necessity of a lookout for such attacks.

It is intimated that the commander-in-chief of the maneuvers indirectly warned the squadron of the possibility of an attack by the *Zédé*. The presence of the *Zédé* seems to have been unsuspected until she discharged her torpedo.

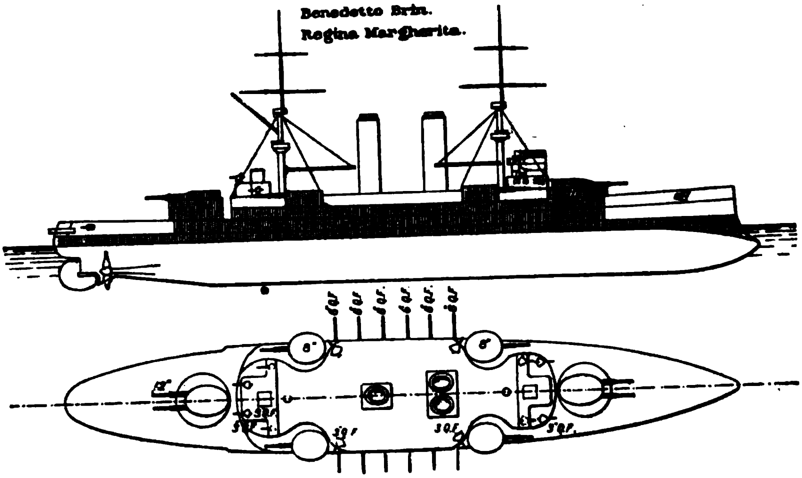
The submarine left under her own power for Toulon, arriving there in safety at an average speed of 8 knots.

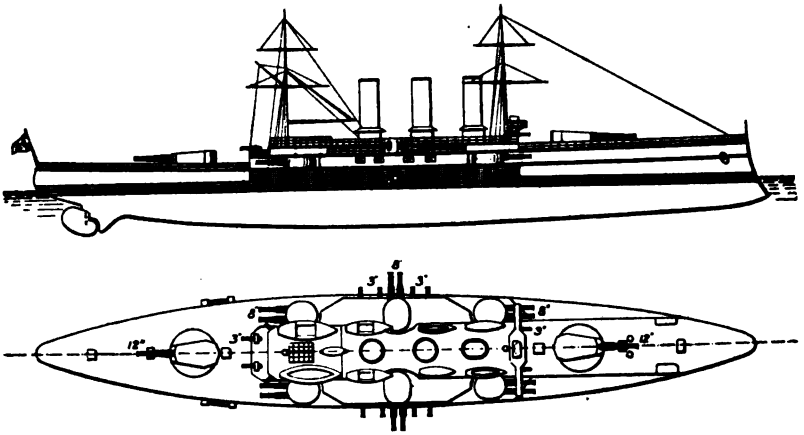
This attack seems to have been made from below the surface. All the reports of the previous attacks speak of the boats rising to the surface to discharge their torpedoes. This would indicate the slight value of the periscope.

—*Notes Naval Progress*, 1902.

### The Most Powerful Battleships of the Principal Powers, now Being Constructed, or Designed to be Built.

If it were desired to set forth clearly what may be called, perhaps somewhat pretentiously, the philosophy of recent naval constructions, it seems that one phrase would suffice and that phrase would be: the pursuit of the *offensive*. What are, in fact, the characteristics of these recent battleships compared to those of former design, if they are not greater speed and more powerful artillery? Every country according to its inclination, its traditions and more especially its budget, has given a different solution of the problem set before it; but all are finally imbued with the true principle of naval warfare, and of all war, namely that to win, one must prepare to attack rather than prepare for defense.


Benedetto Brin.
Regina Margherita.


Vittorio Emanuele
Regina Elena.

ITALY.—It is Italy who formerly with the types *Duilio*, *Italia*, and *Re Umberto*, indicated the line of greater speed and great concentration of fire. True to her policy, she launched in 1901 the *Bendetto-Brin* and the *Regina Margherita*, the speed of both of which is 21 knots* and the aggregate-calibert†

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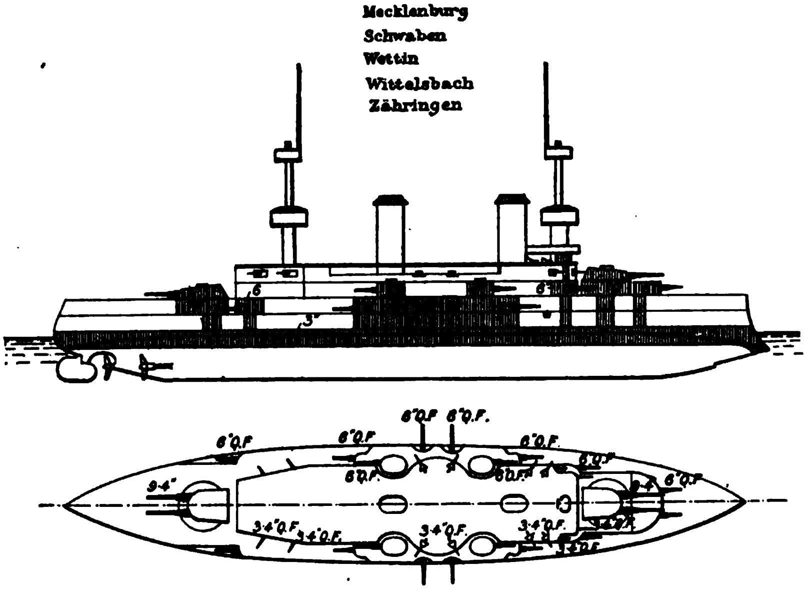
* Brassey gives 19.5 knots.—Ed.

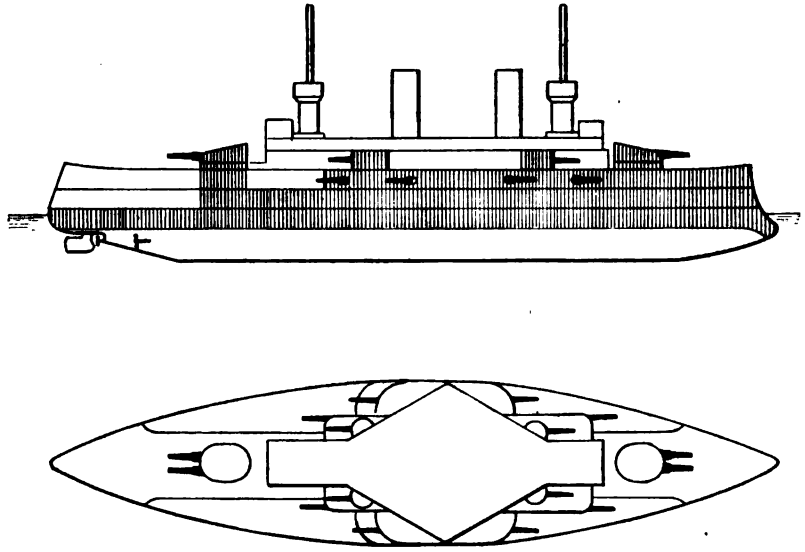
† We shall designate by "aggregate-caliber" the caliber of a fictitious gun having as diameter the sum of the calibers of all the guns of the ship but not including calibers less than 3-inch. Thus the *Benedetto-Brin* has four 12-inch guns, four 8-inch, twelve 6-inch and sixteen 3-inch. It has, then, an aggregate-caliber of:

$$(4 \times 12) + (4 \times 8) + (12 \times 6) + (16 \times 3) = 200 \text{ inches.}$$

This eminently simple way of measuring the power of the main armament seems preferable to others, perhaps more exact, because it leaves out all hypotheses more or less the subject of controversy.

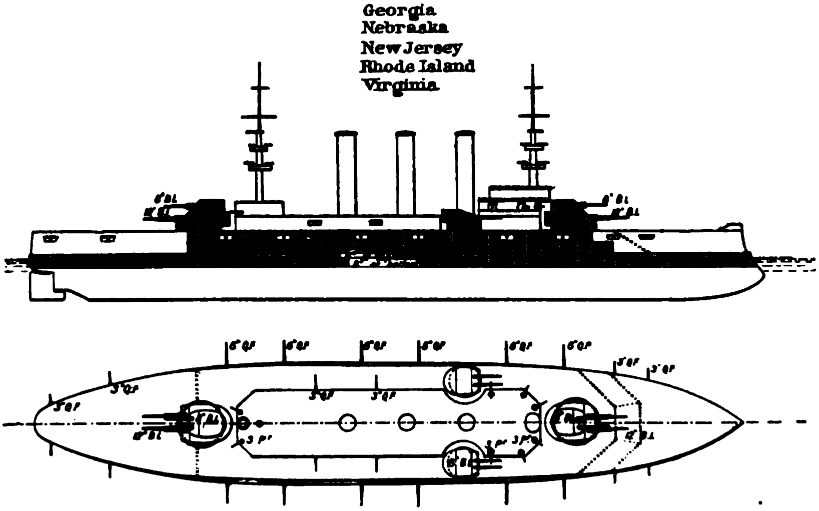
200 inches. In the three new units of the *Vittorio-Emanuele* type, the speed is 22 knots and the aggregate-caliber 156 inches, although the displacement, due undoubtedly to economical reasons, has been reduced from 13,500 tons of





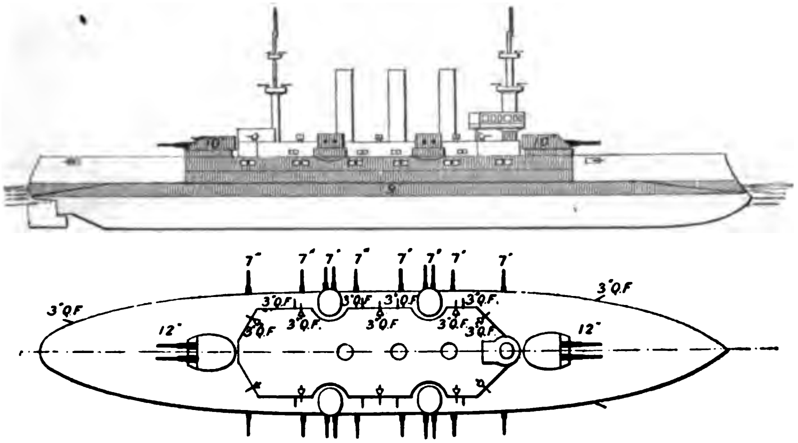
the *Benedetto-Brin* to 12,650 tons. This caliber is somewhat small compared to 200 of the preceding class. It is because the *Vittorio-Emanuele* is a battleship of the same nature as the *République* or the *Duncan*. Her armor protection is of a high order, and one can but admire the concentration of fire that has been secured in this new warship.

GERMANY.—Germay rests satisfied with speeds inferior to those being obtained in Italy. Strategical reasons limit her in regard to large displacements.


Georgia
Nebraska
New Jersey
Rhode Island
Virginia

The offensive power of her battleships, in which the artillery is admirably grouped, is not without being affected thereby. The *Wittelsbach* class (five battleships launched in 1900-1901) have a speed of 19 knots, an aggregate-caliber of 186.4 inches and a displacement of 12,000 tons. The new type (six battleships) will be of 13,000 tons displacement, with armor protection identical with that of the *Wittelsbach*. It will have a speed of 19 knots and its aggregate-caliber will be 205.4 inches.*

Design for
New Battleships.



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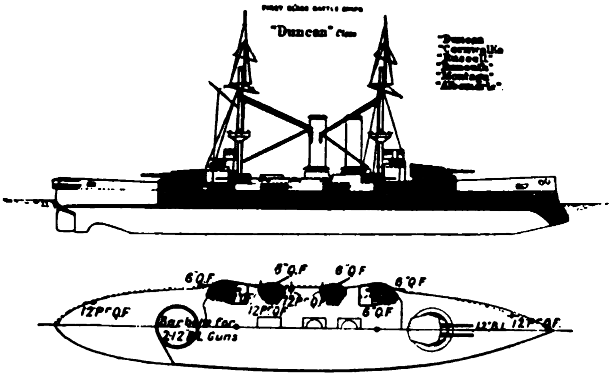
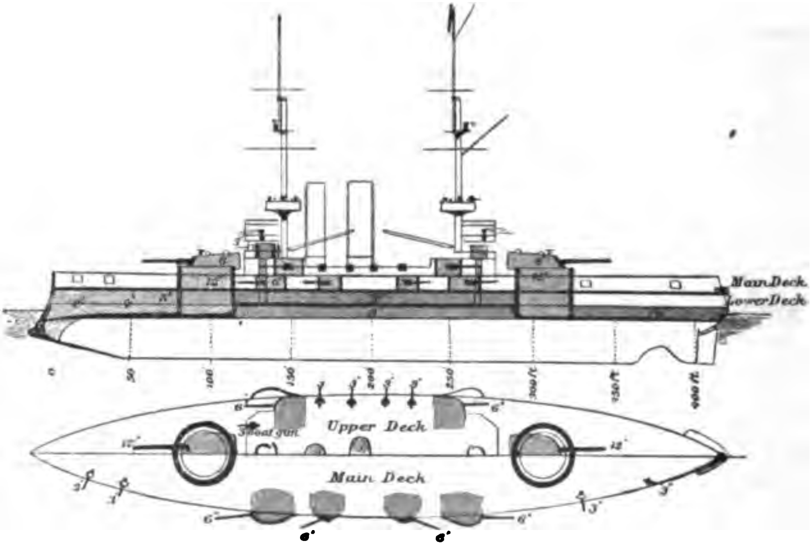
* Four 11-inch, eighteen 6.7-inch and twelve 3.4-inch.

UNITED STATES—In the United States large displacements have been resolutely adopted. The five battleships of the *Virginia* type now being built are of 14,900 tons and the ships of the new design will be 17,581 tons displacement full load. The *Virginia* has a speed of 19 knots and the new type the same. But, while the *Virginia* has an aggregate-caliber of 220 inches, the new type will have 254 inches.

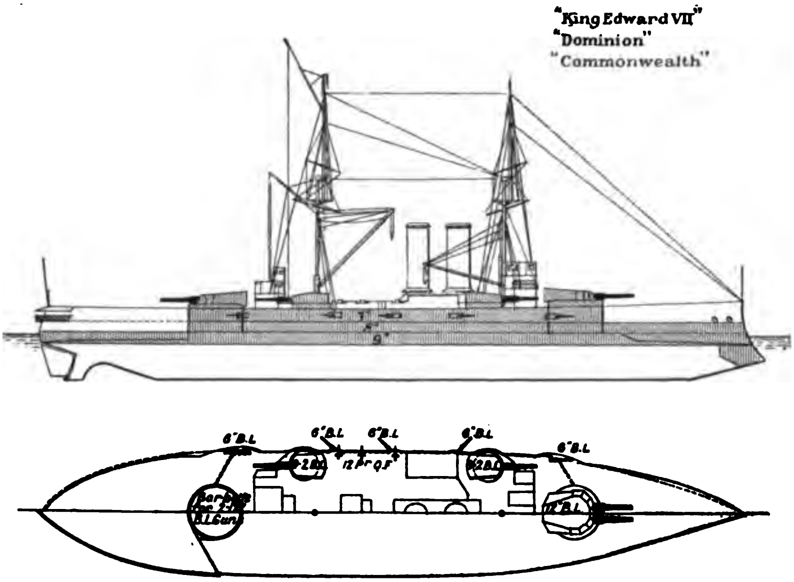


ENGLAND.—England's last three battleships, *King Edward VII*, *Commonwealth* and *Dominion* are of 16,500 tons displacement. Their speed is 18.5 knots and aggregate-caliber 192.8 inches. They do not constitute a very marked advance on the battleships *Queen* and *Prince-of-Wales*, launched in 1902, with a displacement of 15,000 tons, speed 18 knots, and aggregate-caliber of 168 inches. The six battleships of the preceding class (type *Duncan*) had a displacement of 14,000 tons, an aggregate-caliber of only 156 inches, and as compensation, a speed of 19 knots. Considering the displacement, these

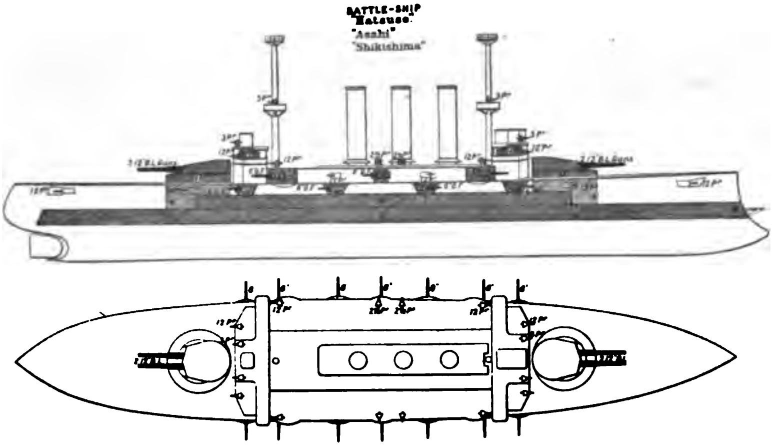


HIS MAJESTY'S BATTLESHIP QUEEN

figures are not very remarkable. Restrained by her traditions and her spirit of conservatism, England has not yet followed the younger navies in their broad conception of the offensive.



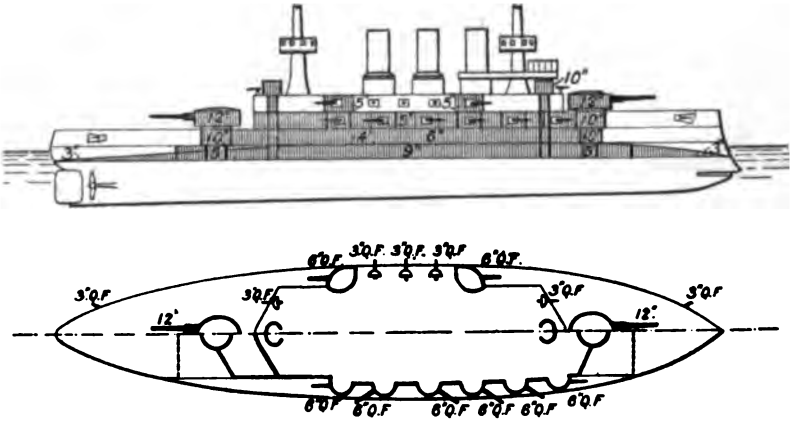
JAPAN.—The ships of the *Hatsuse* type have about 15,000 tons displacement, speed of 19 knots and an aggregate-caliber of 192 inches. This ship is, perhaps, the best example in way of compromise of the many conditions and requirements that make the design of a battleship such a delicate problem. Nothing is sacrificed in it.

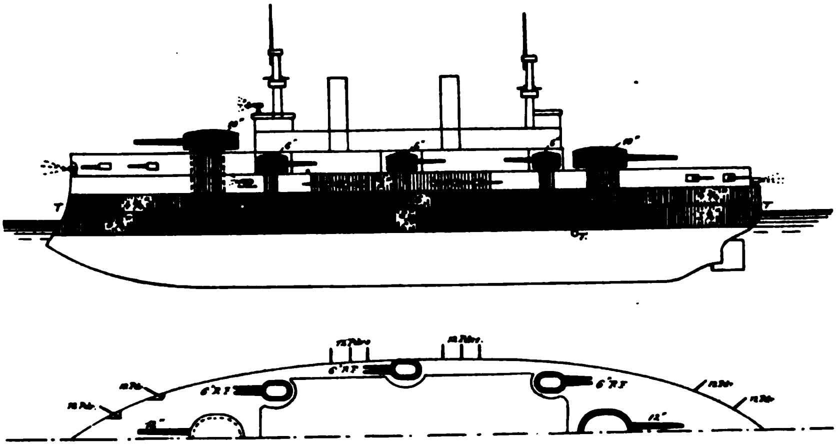


The "Asahi" & "Shikishima" have but Two Funnels

RUSSIA.—It is not the same in Russia, where speed is openly neglected. The *Borodino* class (7 battleships) do not exceed 18 knots. This is a marked advance on the designs prior to 1895 which had only 16 knots, but it is small with respect to the efforts that other countries are making, especially when it is considered that the displacement has increased: 13,600 tons. The aggregate-caliber is 180 inches. As to the *Kuiaz-Potemkin-Tavritchesky*, launched in 1900, with a displacement of 12,480 tons, its aggregate-caliber is 186 inches, but its speed is absolutely insufficient, 17 knots.

**Kniaz Potemkin Tavritchesky**





BORODINO RUSSIAN BATTLESHIP. 13,600 TONS.

FRANCE.—In her naval constructions, France for a long time seems to have considered but one thing: the defensive. Of the former types of her battleships, the *Charles Martel* and the *Saint Louis* are examples of the sacrifices made for protection, the aggregate-caliber of the *Charles Martel* being only 89.6 inches. Commencing with the *Suffren*, France finally decided on having great concentration of fire, and with the six ships of the *République* type she

## TABLE.

| Battleships. | Date of Launch | Speed. | Displacement. | ARMOR. | | | ARMAMENT. (not including guns of less than 3-inch caliber). | Aggregate caliber. |
|---|---|---|---|---|---|---|---|---|
| | | | | Belt. | Gun Position. | Deck. | | |
| | | knots. | tons. | inches. | inches. | inches. | | inches. |
| Benedetto Brin | 1901 | 19.5 | 13,427 | 6 H.S. | 10 H.S. | 3 | 4 12-in., 4 8-in., 12 6-in., 16 3-in. | 200.0 |
| Vittorio Emanuele | Bldg. | 22.0 | 12,625 | 9¾ H.S. | 8 H.S. | 4 | 2 12-in., 12 8-in., 12 3-in. | 156.0 |
| Wittelsbach | 1900 | 18.0 | 12,000 | 9-4 K.S. | 10-6 K.S. | 3 | 4 9.4-in., 18 6-in., 12 3.4-in. | 186.4 |
| New design | Bldg. | 19.0 | 13,000 | 9-4 K.S. | 10-6 K.S. | 3 | 4 11-in., 18 6.7-in., 12 3.4-in. | 205.4 |
| Virginia | Bldg. | 19.0 | 14,950 | 11-8 K.S. | 11-6 K.S. | 3 | 4 12-in., 8 8-in., 12 6-in., 12 3-in. | 220.0 |
| New design | Proj. | 19.0 | 17,580 | 11-8 K.S. | 10-7 K.S. | 3-4½ | 4 12-in., 20 7-in., 22 3-in. | 254.0 |
| Duncan | 1901 | 19.0 | 14,000 | 7 K.S. | 11-6 K.S. | 2½ | 4 12-in., 12 6-in., 12 3-in. | 156.0 |
| Queen | 1902 | 18.0 | 15,000 | 9 K.S. | 12-6 N.S. | 2-1 | 4 12-in., 12 6-in.,* 16 3-in. | 168.0 |
| King Edward VII | Bldg. | 19.0 | 16,350 | 9 K.S. | 12-6 N.S. | 2-1 | 4 12-in., 4 9.2-in., 10 6-in., 16 3-in. | 192.8 |
| Hatsuse | 1899 | 19.1 | 15,000 | 9-4 H.N.S. | 14-6 H.N.S. | 4 | 4 12-in., 14 6-in., 20 3-in. | 192.0 |
| Kniaz Potemkin Tavritchesky | 1900 | 17.0 | 12,480 | 9 K.S. | 12-9 K.S. | 2½ | 4 12-in., 16 6-in., 14 3-in. | 186.0 |
| Borodino | 1901 | 18.0 | 13,566 | 9-4 K.S. | 11-6 K.S. | 4 | 4 12-in., 12 6-in., 20 3-in. | 180.0 |
| République | Bldg. | 18.0 | 14,865 | 11-7 H.S. | 12 | 3¼ | 4 12-in., 18 6.4-in. | 163.2 |
| Average battleship, 1902. | | 18.8 | 14,219 | 8.4-5 K.S. | 9.7-6 K.S. | 3.- | 4 12-in., 14 7.5-in., 12 3-in. | 189.2 |

It may be interesting, at least, to form from this table the average of recent battleship construction :

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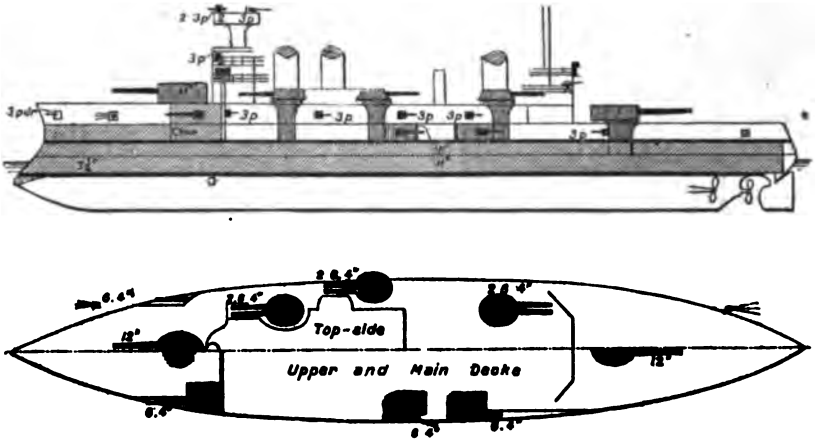
* Instead of 12 6-inch, the *Queen* is to have 8 7.5-inch, and 10 6-inch, thus making her aggregate-caliber 216 inches.



FRENCH BATTLESHIP REPUBLIQUE

has gone far ahead in the pursuit of the offensive. Her new battleships for their displacement of 14,865 tons have an aggregate-caliber of 163.2 inches but their speed is only 18 knots. The *Charles Martel* launched in 1893, gave 18 knots, and the new battleships to be launched in 1903 will not have more.

—*Armee et Marine*, November 16, 1902.

# BOOK REVIEWS.

**The New International Encyclopædia. Volume I. New York: Dodd, Mead & Company. 1902.**

The work before us is a true encyclopædia in every sense, an adequate and satisfactory work of reference, an ideal informer on all important subjects in which the world is interested. It combines the best elements of the three leading encyclopædias of the day, namely, the *Encyclopædia Britannica*, *Larousse* and *Brockhaus' Conversations-Lexikon*, and avoids their defects.

The editors have studied their subject carefully, and have considered the advantages and disadvantages of the methods employed in the three types of encyclopædias above referred to, noting their defects as popular works of reference, and selecting such of their attributes as appear best to fulfill the purposes of an ideal encyclopædia.

These essential attributes are accuracy, comprehensiveness in scope, lucidity and attractiveness of presentation, practical convenience of consultation and proper illustration.

The character of the men selected as editors is a guarantee of the excellence of the work. The editors-in-chief are Professor D. C. Gilman, L.L.D., President of Johns Hopkins University and of Carnegie Institution, Professor H. T. Peck, Ph.D. and L.H.D., Columbia University, and F. M. Colby, M.A., New York University, all men of world-wide reputation and extensive experience and knowledge.

Among the contributors may be mentioned Professor Winship of Harvard University, Professors Waller and Cross of Yale University, Professors Woodberry, Kemp, Gottheil, Giddings, Cushing, Baker and Bailey of Columbia University, Professor Abbott of Dartmouth College, Professor Frothingham of Princeton University, Professors Hall and Loeb of New York University, Professors Ames, Brooks and Howell of Johns Hopkins University, Professor Brumbaugh of the University of Pennsylvania, Professor Hobbs of the University of Wisconsin, Professor Griffis, Imperial University, Tokio, Japan, Professor Church, North-Western University, Professor Paton, Wesleyan University, Professor Howard, Leland Stanford Jr. University, Professor Abbe, U. S. Weather Bureau, F. S. Allen, L.L.B., Chief Editor of Webster's International Dictionary, Russell Sturgis, Editorial Staff of the Century Dictionary and of Webster's International Dictionary Associate Justice D. J. Brewer, U. S. Supreme Court, T. F. Rodenbough, Brevet Brigadier-General, U. S. Army, Gustav Kobbe, Music Critic, *New York Herald*, J. G. Huneker, Music Critic, *New York Sun*, and a number of other authorities in the various departments of literature, science and art.

The first volume is probably a type of all the others. It comprises the words from A to ARMERIA in a volume of 822 pages, with 7 colored plates, 15 maps, and 32 engravings, all of them full-page illustrations, besides a large number of smaller cuts.

To give a clear idea of the character and scope of the work, we will select a few words at random and explain the manner of treatment.

The first word we turn to is *Advance Guard.* Under this heading the necessity for this body of troops is explained, its strength and composition under various conditions is discussed, and a diagram from Meckel, the great German authority on *tactics*, illustrates the article. The order of march and the duties of the different subdivisions are described in general terms, and the article is completed by a brief description of the purpose, duties and composition of flank and rear guards, and the essential differences in advance guards of the different armies of to-day.

*Aeronàutics* is our next word, and here we find an illustrated article of about seven printed pages, with an excellent bibliography at the end. After tracing the history of balloons, including captive and dirigible balloons, the article describes a number of high ascents, long distance trips and scientific research by means of balloons. A special section is devoted to military ballooning and another to mechanical flight. The illustrations of this article comprise Count Zeppelin's dirigible balloon, Langley's aerodrome, Lilienthal's and Chanute's apparatus for soaring flight and Santos-Dumont's airship.

In the general subject of biography we turn first to *Aguinaldo*, whose life is briefly narrated down to his taking the oath of allegiance to the United States on April 2, 1901. Next we turn to *Alexander the Great*, to whom one full page is devoted, the article being illustrated by an excellent plate of the marble bust of Alexander in the Berlin museum. A good bibliography is also added. *Fra Angelica* is another biographical notice, this time of a gifted Italian painter, illustrated by a beautiful plate representing his Madonna of the Star in the convent of San Marco, Florence. This short article is a beautiful tribute by one who was evidently inspired by the artist's character and work.

The few geographical articles which we select, (*Artic Regions*, *Anartic Regions*, *Abyssinia*, *Alaska*, *Afghanistan*, *Alsace-Lorraine*, *Amazon*, *America*, *Arizona*, *Alps*, *etc.*,) are mostly illustrated by special maps, and the first two above mentioned contain the very latest data on discoveries in these regions. Under the heading *Alps* the fauna and flora are also described and a very complete bibliography is appended.

The subjects of *Architecture* and *Archæology* are both beautifully illustrated, and the separate article on the *Arch* adds to the former subject some very interesting and useful material, especially in a plate representing 24 different forms of arches.

It is hardly necessary to analyse any more articles in order to illustrate the character of the work.

The colored plates are representations of plants, animals and architectural works; the maps are of continents and states, but an excellent map of the *Antilles* is added, which gives the mail steamer lines, railroads and submarine cables; and the engravings comprise works of art, flowers and plants, cities, animals, machinery, etc. The varieties of *Antelope* are represented on two plates, one of which is colored, and the works of art include the Apollo Belvedere, Fra Angelica's Madonna of the Star, Amiens Cathedral, Alma-Tadema's at the Shrine of Venus, the Alhambra, stone reliefs of Rock Temple at Abu-Simbel, the Parthenon and the Temple of Karnak, all excellent reproductions.

The New International Encyclopædia is without doubt the ideal encyclopædia of the day. The editors and contributors were men selected for their special abilities, and all are men familiar with the encyclopædias now in use and have appreciated the defects and the merits of each, consequently they were particularly fitted to produce a better work, for the definite purpose desired, than any now in use.

The encyclopædia is not only a convenient reference book, however, it is also a library, and especially must it fulfill this requirement where other libraries are not available. The army or navy officer has constant use for works of reference, and for libraries, but since he is often separated from the latter, his only resource is to possess the best of the former and carry it with him, if he desires to keep informed on the world's history, progress and art.

J.P.W.

**Lectures on Explosives. A course of Lectures prepared especially as a Manual and Guide in the Laboratory of the U. S. Artillery School. By Willoughby Walke, Captain, Artillery Corps, U. S. A. 3rd Edition, revised and enlarged. New York: John Wiley & Sons. 1903 Pp. xvi+435. O. Red Cloth, $4.00.**

Captain Walke's work, the Service authority on the subject it treats of, the text-book in the practical laboratory work in the course of explosives at the U. S. Artillery School, and the standard officially adopted for the examination of officers of artillery for promotion, is too well known both in the Service and to the general student to require special notice or criticism here.

The success of the preceding editions both at home and abroad bear witness to the usefulness and value of the book. Although primarily intended as an aid to the artillery students pursuing the post-graduate course at the Artillery School, the demand for information on the subject of explosives has been exacting and great, and thus has required amplification and extension of the book far beyond the scope of the original work. It has been endeavored to meet this demand by keeping the work up to date, and, in the present edition, the Lectures have been further corrected in some minor details and there has been added such new matter as has been accepted by the best authorities on explosives.

In this revised edition, there have been incorporated the Service regulations for the examination, care, and storage of smokeless powders in store at depots, including instructions for regulating powder charges in target practice, and particular attention has been given to recent modifiations of the tests of explosives. These include the principal tests that have been recently proposed by notable investigators who have undertaken to establish more reliable stability tests of nitrocellulose in general and of guncotton in particular; Guttman's, Hottsema's, Vieille's, and Thomas's tests are given and also, and by far the most important, the elaborate test proposed by Professor W. Will of the Laboratoire Centrale, Neu-Babelsberg, Prussia, known as the Will test, which may be considered the best test for stability yet proposed.

These new features added to the excellence of the subject matter of the preceding editions as regards process of manufacture, densimetry, analysis of explosives, their classification and use, make the book, in its present form, exceedingly satisfactory and complete, and will undoubtedly render these Lectures of even greater value than before.

The same general arrangement has been followed as in former editions; the paper is good, the type large and clear, and the book is firmly and serviceably bound in red cloth. It should be in the possession of every artillery officer both for study and reference.

H. Jr.

**Notes on Fortification With a Synoptical Chart. By Major B.R. Ward, R.E. New York: E. P. Dutton & Co. London: John Murray. 1902. Pp. 50. Q. Red Cloth, 5s. 6d. net.**

It is a veritable pleasure to take up a book such as this, derived both from its attractive appearance, its broad-margined pages of large clear type, and also from the interesting manner in which a large amount of valuable information is imparted. It is intended as a short addition to the present stock of literature on the subject of Fortification and the author's aim has been to impart interest to the initial study of a subject which has been considered dull on account of the mass of technical details connected with it.

The notes are to serve then as an introduction to the study of Fortification. They place before one in condensed form a most interesting and instructive review of the evolution of the subject from the invention of gunpowder to the present time.

Sections I. and II. are devoted respectively to permanent fortification and sea-power, and sketch their development, the progress made and the changes adopted consequent on the improvement made in weapons, and, in the case of sea-power, on the application of steam to warships.

Section III. deals with coast defense: A branch of the larger subject of sea-power; varying inversely as naval power; standard required; mounting the armament; the science of coast fortification; methods of mounting guns; Q. F. guns,—these, forming some of the headings given, indicate the field covered, every line of which is suggestive and rich in food for further thought and study.

The definitions, functions and requirements of submarine defense, with a few remarks on electric lights, are given in Section IV., while Section V. sketches briefly the organization of the Corps of Royal Engineers.

To the general reader and those interested in graphical representations, the Synoptical Chart will no doubt prove the most interesting part of the book. This chart has been compiled on the Scaife system of historical charts, and contains a wonderful fund of information on the evolution of fortification, of artillery and small arms, and tactics from the thirteenth century to the present time (1900). Other columns give the rulers of England and France, the principal wars that have occurred, the eminent men of science, artillerists and engineers, with the periods in which their influence was felt. The right half of the chart is devoted to factors relating to sea-power and coast defense, such as chief materials used in ship construction, chief naval weapons, system of mounting guns for coast defense, rapidity of discharge, and several others of like importance.

This chart will prove most useful in the study of military history, and we think it ought to be found in all of our service schools of application, as from it can be seen at a glance the nature and power of the weapons in use and everything connected with the art of war at any particular period.

The book is interleaved throughout and, in addition, there are about twenty blank pages at the end for further notes in the course of one's study of the subject.

The book is attractively bound in red cloth and in all respects reflects credit upon the publishers. H. Jr.

**Customs of the Service. The Army, National Guards, and Volunteers. By Colonel James W. Powell, United States Army. Revised Edition. Kansas City, Mo.: The Hudson-Kimberly Publishing Co. 1902. Pp. x + 285. S. Blue Cloth, $1.50.**

This little manual has proved so popular that this new edition, revised and brought up to date, has been issued. The original edition was written during the season of active operations and was designed more especially to cover service in the field. Legislative enactments, General Orders and recent experiences of the author have contributed many valuable and essential emendations which, with garrison duties, are now incorporated.

In the revised edition are introduced matters of interest especially to officers joining for duty upon original entry with commissions, and many other features which are lacking in the earlier editions. Among these may be found: The proper formalities to be observed in first reporting for duty—oral and written report being required; uniform worn; quarters and messing; knowledge of the conventional courtesies necessary at the military posts, which will possibly in some cases avoid the embarrassment of inexperience; mileage allowed on journeys; commencement of pay; the details of performance of guard duty; command of men; observances of army sanitation; reports required—to whom and when; boards of survey, duties of the recorder, the junior member; judge advocate of courts-martial; preparation of muster-rolls and Final Statements; form for official communications.

These embracing a few of the interesting subjects considered in this edition, in addition to notes on the service of troops in campaign, transportation by rail and water, battles, marches, and out-post duty, give some idea of the scope of this essentially *practical* work.

It should continue to prove very useful, since many officers and non-commissioned officers of our army, without much previous service or experience, are nowadays called to responsible positions without being afforded the time or the opportunity to acquire a knowledge of army customs in the old way of experience and observation. H. Jr.

**Notes on Laying, Repairing and Testing Submarine Cables. U. S. Signal Corps. Prepared under the direction of Brigadier-General A. W. Greely, Chief Signal Officer, U. S. Army, by Captain Edgar Russel, Signal Corps. With supplementary chapter on Factory Testing, by Lieutenant-Colonel Samuel Reber, Military Secretary. Washington: Government Printing Office. 1902. Pp. 70.O. Blue Cloth.**

This book opens by giving an excellent idea of the make-up of a cable and the coiling of it in the hold of a vessel preparatory to laying it. Splicing is well described and two cuts makes the process quite plain. The system by which messages are sent over a cable is illustrated, as well as many of the instruments used therein; these with the text make clear the general method of procedure.

Cable testing is then taken up. The manner of treatment is best shown by quoting the book itself:

"It is proposed to describe such tests as are usually desirable at cable stations, leaving the description of complicated apparatus and methods, together with the mathematical demonstrations, to the works cited. For the more elaborate tests required on cables of over 200 miles in length reference is made to the standard works quoted."

After brief descriptions of a few galvanometers, the author describes concisely and clearly the method of finding the constant of a galvanometer, explaining the term and giving the formula for determining it. The diagrams for preparing the cable and making the connections are clear and satisfactory.

A description of a method of cable testing requiring only a few cells of a battery and a telephone receiver is explained and a cut of the connections makes it clear. This same clearness, both in description and cuts showing connections, is found in the author's treatment of measurements for "capacity" and "conductor resistance."

In the part of the book devoted to "location of faults", we find a detailed statement of the faults that may be expected, and these are classified and treated in order. When more elaborate descriptions exist, they are referred to, the name of the treatise being given.

The Fisher testing set is described at some length and is accompanied by an explanation of its application to the various measurements necessary in cable work.

The matter relating to "Factory Tests" is interesting principally to officers who are inspectors of cable, but at the same time gives a good idea to the layman of the care taken in making and testing the cable before it leaves the factory.

The closing pages are devoted to tables and formulæ ; the last page gives a graphical scale of coefficients for the reduction of insulation resistance of different materials at different temperatures, to that at 60°.

The general appearance of the book is excellent; the type clear and the paper good. There are few pictures, the illustrations being mostly diagrammatic, which feature appeals strongly to a reader who is not already an expert and who wishes to know just exactly how he can prepare his apparatus to make the test in hand.

The author has had considerable experience in this work, and it is clearly seen that he has not only learned how to make the tests he describes, but that he appreciates just where the difficulties will be found by others in learning how to do the same thing.

This book is a distinct departure in "Notes" of this character, and the Signal Corps is to be complimented on its production.

H.C.D.

**The Anglo-Transvaal War. Notes of the Boer General Villebois de Mareille. Translation from the French. St. Petersburg: Commissioner of the Russian Military Educational Institution. 1902. Pp. 149.O. Paper.**

This pamphlet consists of the notes and observations of the French Colonel Villebois de Mareille on the operations in South Africa, beginning with November 24, 1899, the date of his departure from Lorenzo Marques to join the Boer forces, and ending with March 7, 1900. The author, as may be known, was of the French army, retired. He had received the highest military training and had taken part in several of the French Colonial wars, but retired from service due to difference of views between himself and the French General Staff as to matters of policy.

When the South African war broke out, he threw his fortunes with the Boers, and was shortly after made chief of staff to General Joubert at the time of the latter's operations in Natal. Afterwards he organized the Foreign Legion, and, after Joubert's death, was appointed to the command of it with the rank of general.

These notes give his impressions and experiences up to the time of the organization of the Foreign Legion. They are especially interesting from one point of view. The author had been thoroughly trained in European ideas of organization and military operations. On his arrival in Africa, he utterly failed to appreciate the peculiar conditions which gave such success to the Boer methods. The conditions which he failed to understand at the outset were not merely those of *terrain*, but those growing out of the peculiar national characteristics of the Boers, both patriotic and religious. He shows the same bitter disappointment that European trained officers always have evinced when they have taken part in American wars from the Revolution to the Rebellion. Nevertheless, he rendered the Boers good service, and his death was a distinct loss to them.

He was killed in an engagement at Boshof, where with 80 of the foreign volunteers he stood off a force of English about 30 times his own number for 3½ hours.

**West Point in the Early Sixties. J. P. Farley, U. S. Army. 1902. Troy, N. Y.: Pafraet's Book Company. Pp. 201.**

Colonel Farley has collected in this volume his reminiscences of Cadet days, and of the early days of the civil war, and has woven the separate strands into a connected whole, loosely held together but still harmonious and reflecting the mellow light of other days on the events recorded.

The period of time covered by this narrative was naturally exciting and interesting, and the author has done full justice to his subject. The style is entertaining, with the charm that attaches to all personal memoirs, especially those of historic scenes, and the volume is fascinating throughout, with sufficient variety to relieve and refresh the mind, and with the accuracy of historic record.

The spirit it breathes is just and fair, and the book must inspire love of our country and faith in our great military academy at West Point.

J.P.W.

**La Defense de nos Côtes. By Cabart-Danneville, Deputé. Paris: Librairie Hachette et Cie. Pp. 402. D. Paper.**

In this book, written when the reorganization of the French system of coast defense was receiving attention, the author makes a strong and decisive argument in favor of a more thoroughly organized system than had obtained up to that time, and of putting the defense of the French coast completely in charge of the navy. He bases his argument on facts resulting from most thorough investigation of historical data, of the conditions existing in France requiring a more efficient defense, and of the various systems of other European countries. The book thus contains a great amount of interesting and useful information on the development of coast defense in Europe, particularly in France, and on some of the principal factors relating to coast defense.

We have had occasion in a former volume of the *Journal* to reprint some extracts from the interesting arguments of the author treating of the defense of the German and Austro-Hungarian coasts, which well illustrate the nature of some of the statistical information the book contains.

**Aerial Navigation. A practical Handbook on the Construction of Dirigible Balloons, Aërostats, Aëroplanes and Aëromotors. By Frederick Walker, C. E. New York: D. Van Nostrand Company. 1902. Pp. xvi+151. D. With about one hundred illustrations. Brown Cloth, $3.00.**

Since recent successful experiments and commercial enterprise have combined to render aerial navigation a prominent feature in progressive science, the present volume appears most opportunely. It treats of the laws governing flight as exemplified by animals, birds, and insects, and of the construction of dirigible balloons, aërostats, aëroplanes, and aëromotors to be synthetically deduced therefrom, and illustrated by various types already made. As its sub-title indicates, it is *practical* handbook on the subject, and is in all respects an excellent one.

The author's aim has been to convey elementary instruction in a popular manner, and he has succeeded in presenting in readable fashion a thoroughly practical basis upon which the airship may be constructed and understood in its action.

Commencing with the laws which govern flight in Nature's realm, the author discusses in successive chapters aërostatics, aërodynamics, screw propulsion, paddles, etc., motive power (engines, motors, etc.), structure of airships and materials, with full descriptive details under each. The text is supplemented by over one hundred diagrammatic drawings and illustrations which of are great assistance, and clearly set forth the principles of construction involved. The book also includes some useful data and tables on wind resistance, height of barometer for various altitudes with table of temperature corrections, corrections for latitude, and a table of useful constants.

The author is optimistic in regard to the future development of the airship, yet with just discrimination as regards the difficulties to be overcome. "Aerial navigation can only effect a revolution in international matters by the discovery and application of the neutralisation and regulation of the force of gravity. Its practical development is slow relatively to other modes of locomotion, the chief cause lying in the fact that any disaster is nearly sure to be fatal to human life. There have been disasters in this enterprise—as there always will be, to the end of time, whenever man seeks to conquer the unknown. Though in the olden times navigators went forth to explore the unknown expanse of the ocean and returned no more, yet today the ocean greyhound is an everyday sight, and the airship will soon cease to cause astonishment."

H. Jr.

## EXCHANGE AND BOOK NOTICES.

**Lewis and Clark Journals.** History of the expedition under the command of Captains Lewis and Clark to the Pacific 1804-6. With maps. In three volumes. New York: New Amsterdam Book Company. 1902. Pp. 415 per volume. S. Cloth, $1.00 per volume.

**Traccia per lo Studio della Fortificazione Permanente.** E. Rocchi, Lieutenant-Colonel of Engineers. Torino: Tipografia Roux e Viarengo, 1902. Pp. viii+449. O. With 90 separate plates.

**Balistica Esterna.** By Cap. di Fregata G. Ronca e Prof. A. Bassani. Livorno: Tipografia di Raffaello Giusti. 1901. Pp. xvi+487. O. Paper, L.14.

**Manuale del Tiro.** By Commandante G. Ronca. With an appendix on "Nomography" by Prof. Pesci. Livorno: Tipografia di Raffaello Giusti. 1901. Pp. xvi+586+LVII. With ten plates. Paper. L. 10.

**Manuale di Balistica Esterna.** By Commandante G. Ronca. Livorno: Tipografia di Raffaello Giusti. 1901. Pp. xxxii+357. O. With 38 plates. Paper, L. 14.

**Practical Hints for Mounted Infantrymen.** By Captain B. L. Anley, D. S. O., 2d. Essex Regiment. Second Edition-Revised. London: Gale and Polden, Ltd. 1902. Pp. viii+42. Tt. Sixpence.

**Patrolling in South Africa,** with Hints on Training Scouts at Home. By Captain C. F. Vander Byl, 16th Lancers. Second Edition. Illustrated. London: Gale and Polden, Ltd. 1902. Pp. viii+79. Tt. Sixpence.

**The A B C of Photo-Micrography.** A Practical Handbook for Beginners. By W. H. Walmsley. New York: Tennant and Ward. 1902. Pp. viii+155. D. With xiii plates. Cloth, $1.25 net.

**Frankreichs Küsten-Verteidigung.** Für Offiziere aller Waffen, By W. Stavenhagen. Berlin: Richard Schröder. 1902. Pp. 62. O. Paper, M. 2.

We would call the attention of our readers to the periodicals cited in the index to current literature, the list of which appears in this number. This list has been revised, rearranged, and in some cases the abbreviations formerly used in the index have been changed. It also includes some new periodicals recently added.

Chief among these will be found **Page's Magazine**, an illustrated technical monthly dealing with the engineering, electrical, shipbuilding and mining industries.

The numbers that have thus far appeared have been of a high order, containing matter that appeals both to the technical professions and general reading public. The illustrations, especially, are most excellent, are most numerous and cover fully all the subjects discussed. The Department of Naval Notes is a prominent one and contains valuable information on naval progress in construction and armament of the leading Nations. In the January number we may mention an excellent article on the Distribution of Guns in Battleships by John Leyland, illustrated by the most recent types of battleships; but the whole table of contents attracts by the names and articles therein contained.

Another technical publication is **Science and Industry** published at Scranton, Pa. This is an eminently practical monthly devoted to electrical and engineering subjects in which is always to be found useful information. "Water rheostats for testing purposes"; "the principles of electrical measuring instruments"; "generating power from oil fuel"; "firing a steam boiler"; "practical points on lubricating oils"—indicate to a slight extent the contents of some recent numbers.

Amongst the foreign periodicals, we welcome with much pleasure the appearance of the **Liga Naval Portuguesa**, the leading maritime publication of Portugal. This is an illustrated monthly bulletin of this society, and contains naval and maritime information and notes of interest.

For an excellent weekly review of the developments in science, literature and art we can warmly recommend **Die Umschau**, both for the general reader as well as for the professional man. It gives the latest information on the progress made in scientific research, and amongst its contributors are the names of well-known authorities in medicine, physics, astronomy, sociology, etc. In recent numbers will be found interesting discussions on "The Degeneration of Man" by Dr. Sioli; "Is the phenomenon of life completely and scientifically explainable?" by Dr. Jacques Loeb; "Is the moon a dead Planet?" Prof. Pickering; "Recent excavations in Crete," fully illustrated, by Dr. Robert Zahn; amongst many other articles of equal interest and importance.

The **ENNO SANDER PRIZE**, of **The Association of Military Surgeons of the United States** for 1903 will be awarded to the author of the best essay on:

The Differential Diagnosis of Typoid Fever in its Earliest Stages.

The board of award will consist of,

Dr. Austin Flint of New York,
Colonel Calvin DeWitt of the Army,
Prof. Victor C. Vaughan of Ann Arbor.

Full information concerning the contest may be obtained from **Major James Evelyn Pilcher, Carlisle, Pa.**, the Secretary of the Association.

# INDEX TO CURRENT MILITARY LITERATURE.

## PERIODICALS CITED.

Abbreviations employed in index are added here in brackets.

All the periodicals are preserved in the Artillery School Library, Fort Monroe, Virginia.

### ENGLAND.

**Aldershot Military Society.** *Occasional.*
*Aldershot.* *Copies 6d each.*

**Arms and Explosives.** [*Arms and Ex.*] *Monthly.*
*Effingham House,* *Per year* 7 *s.*
*Arundel Street, Strand, London, W. C.*

**Army and Navy Gazette.** [*A. and N. Gaz.*] *Weekly.*
3 *York Street, Covent Garden,* *Per year* £1 12*s* 6 *d.*
*London. W. C.*

**Canadian Military Gazette.** [*Can. Gaz.*] *Fortnightly.*
232 *McGill Street,* *Per year* $2.00.
*Montreal, Canada.*

**The Engineer.** [*Eng.*] *Weekly.*
33 *Norfolk Street, Strand,* *Per year* £2 6 *d.*
*London, W. C.*

**Engineering.** [*Eng'ing.*] *Weekly.*
35-36 *Bedford Street, Strand,* *Per year* £2 6 *d.*
*London, W. C.*

**Journal of the Royal United Service Institution.** *Monthly.*
*Whitehall, London, S. W.* [*Jour. R.U.S.I.*] *Per year* 24 *s.*

**Journal of the United Service Institution of India.** *Quarterly.*
*Simla, India.* [*Jour. U. S. I. India*] *Per year* $2.50.

**Page's Magazine.** [*Page Mag.*] *Monthly.*
*Clun House,* *Per year* 16 *s.*
*Surrey Street, Strand, London, W. C.*

**Photographic Journal.** [*Photo. Jour.*] *Monthly.*
66 *Russell Square, London.* *Per year* 12 *s.*

**Proceedings of the Institution of Civil Engineers.** *Annual.*
25 *Great George Street,* [*Proc. I. C. E.*]
*Westminister, London, S. W.*

**Proceedings of the Institution of Mechanical Engineers.**
*Storey's Gate* [*Proc. I. M. E.*]
*St. James' Park,*
*Westminister, London, S. W.*

**Proceedings of the Royal Artillery Institution.** *Monthly.*
*Woolwich, England.* [*Proc. R. A. I.*]

**Professional Papers of the Corps of Royal Engineers.**
*Chatham, England.* [*Prof. Papers C. R. E.*]

**Review of Reviews.** [*Rev. Austral.*] *Monthly.*
169 *Queen Street, Melbourne, Australia.* *Per year* 10 s. 6 d.

**Transactions of the Canadian Institute.** *Annual.*
58 *Richmond Street,* [*Trans. Can. Inst.*]
*Toronto, Canada.*

**Transactions of the Canadian Society of Civil Engineers.**
*Montreal, Canada.* [*Trans. Can. Soc. C. E.*]

**Transactions of the Institute of Naval Architects.**
5 *Adelphi Terrace,* [*Trans. Inst. N. A.*]
*London, W.C.*

**United Service Gazette.** [*U. S. Gaz.*] *Weekly.*
245 *Dashwood House,* *Per year* £1 10 *s* 6 *d.*
*New Broad Street, London, E. C.*

**United Service Magazine.** [*U. Serv. Mag.*] *Monthly.*
23 *Cockspur Street, Charing Cross,* *Per year* 27 *s.*
*London, S. W.*

## FRANCE.

**Armée et Marine.** [*A. Marine.*] *Weekly.*
3 *Place du Théatre Français, Paris,* *Per year* 35 *Fr.*

**Le Génie Civil.** [*Génie C.*] *Weekly.*
6 *Rue de la Chaussée d'Antin, Paris.* *Per year* 45 *Fr.*

**Le Livre Militaire.** [*Livre Mil.*] *Monthly.*
6 *Rue de la Chaise, Paris.* *Per year* $1.00.

**La Marine Française.** [*Marine F.*] *Semi-monthly.*
26 *Rue de Grammont, Paris.* *Per year* 30 *Fr.*

**Mémoires et Compte Rendu des Travaux de la Société des Ingénieurs Civils.**
19 *Rue Blanche,* [*Memoires I. C.*] *Monthly.*
*Paris.* *Per year* 36 *Fr.*

**Le Monde Militaire.** [*Monde.*] *Fortnightly.*
6 *Rue de la Chaise, Paris.* *Per year* 8 *Fr.*

**Revue d'Artillerie.** [*R. Artillerie.*] *Monthly.*
5 *Rue des Beaux-Arts, Paris.* *Per year* 22 *Fr.*

**Revue de Cavalerie.** [*R. Cav.*] *Monthly.*
5 *Rue des Beaux-Arts* 5, *Paris.* *Per year* 53 *Fr.*

**Revue du Cercle Militaire.** [*Cercle.*] *Weekly.*
37 *Rue de Bellechasse, Paris.* *Per year* 27 *Fr.*

**Revue du Génie Militaire.** [*Génie M.*] *Monthly.*
5 *Rue des Beaux-Arts, Paris.* *Per year* 27 *Fr.*

**Revue d'Infanterie.** [*R. Inf.*] *Monthly.*
10 *Rue Danton, Paris.* *Per year* 25 *Fr.*

**Revue Maritime.** [*R. Maritime.*] *Monthly.*
*Rue et Passage Dauphine* 30, *Paris.* *Per year* 56 *Fr.*

**Revue Militaire des Armées Etrangères.** *Monthly.*
*R. Chapelot et Cie.,* [*R. M. Etrang.*] *Per year* 15 *Fr.*
*Rue et passage Dauphine* 30, *Paris.*

**Revue Militaire Universelle.** [*R. Univ.*] *Monthly.*
10 *Rue Danton, Paris.* *Per year* 25 *Fr.*

**Revue des Questions Militaires.** [*Quest. Mil.*] *Monthly.*
6 *Rue de la Chaise, Paris.* *Per year* 15 *Fr.*

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| **Le Yacht—Journal de la Marine.**[*Yacht.*] | *Weekly.* |
| 55 *Rue de Chateaudun, Paris.* | *Per year* 30 *Fr.* |

### GERMANY.

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| **Die Armee.** [*Armee.*] | *Weekly.* |
| *Jul. Bagel. Mülheim-Ruhr.* | *Per year* 9 *M.* |
| **Beiheft zum Militaer-Wochenblatt.** | *Occasional.* |
| *Koch Strasse*, 68, [*Beiheft.*] | |
| *Berlin. S. W.*, 12. | |
| **Illustrirte Aeronautische Mittheilungen.** | *Quarterly.* |
| *Kalbgasse* 3, *Strassburg.* [*Aeronaut. Mitth.*] | *Per year M.* 6.86. |
| **Internationale Revue.** [*Int. Rev.*] | *Monthly.* |
| *Weintraubenstrasse* 21, 1. | *Per quarter* 8 *Fr.* |
| *Dresden–N.* | |
| **Jahrbuecher fuer die deutsche Armee und Marine.** | *Monthly.* |
| *Mohren Strasse*, 19, [*Jahrbuecher.*] | *Per year* 24 *M.* |
| **Kriegstechnische Zeitschrift.** [*Kriegstech.*] | *Ten numbers a year.* |
| *Koch Strasse*, 68-71, *Berlin, S. W.* | *Per year* 10 *M.* |
| **Marine Rundschau.** [*Rundschau.*] | *Monthly.* |
| *Koch Strasse*, 68-71, *Berlin, S. W.* | *Per year* 8 *M.* |
| **Militaer-Wochenblatt.** [*Wochenblatt.*] | *Semi-weekly.* |
| *Koch Strasse*, 68, *Berlin, S. W.* 12. | *Per Year* 20 *M.* |
| **Schiffbau.** [*Schiffbau.*] | *Semi-monthly.* |
| *Emil Grottke's Verlag*, | *Per year* 18 *M.* |
| *Wilhelmstrasse* 105, *Berlin, S. W.* | |
| **Stahl und Eisen.** [*Stahl u. Eisen.*] | *Fortnightly.* |
| *Jacobistrasse* 5, *Düsseldorf.* | *Per year* 24 *M.* |
| **Die Umschau,** [*Umschau.*] | *Weekly.* |
| *H. Bechhold Verlag*, | *Per year M.* 21.20. |
| *Frankfort A. M.* | |

### AUSTRIA.

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| **Mittheilungen aus dem Gebiete des Seewesens.** | *Monthly.* |
| *Pola.* [*Seewesens.*] | *Per year* 17 *M.* |
| **Mittheilungen ueber Gegenstaende des Artillerie und Genie-Wesens.** | |
| *Getreidemarkt* 9. [*Mitth. Art. u. G.*] | *Monthly.* |
| *Wien, VI*, | *Per year* 20 *M.* |
| **Organ der Militaer Wissenschaftlichen Vereine.** | 8-14 *numbers.* |
| *Strauchgasse No.* 4 [*Organ.*] | *Per year* 20 *K.* |
| *Wien I.* | |
| **Zeitschrift des Oesterreichischen Ingenieur und Architekten Vereines.** | |
| *Eschenbachgasse, No.* 9. [*Zeitschr. I. A. V.*] | *Weekly.* |
| *Wien. I.* | *Per year* 30 *K.* |

### SWITZERLAND AND BELGIUM.

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| **Allgemeine Schweizerische Militaer-Zeitung.** | *Weekly.* |
| *Basel, Switzerland.* [*A.S.M. Zeit.*] | *Per year*, 8 *Fr.* |
| **La Belgique Militaire.** [*Belgique M.*] | *Weekly.* |
| *Rue Albert de Latour*, 50, | *Per year F.* 12.50. |
| *Schaerbeek, Brussels.* | |

**Revue de l'Armée Belge.** [*A. Belge.*] *Bi-monthly.*
22 *Rue des Guillemins, Liège, Belgium.* *Per year* 13 *Fr.*

**Revue Militaire Suisse.** [*R. M. Suisse.*] *Monthly.*
23 *Escaliers-du-Marché, Lausanne, Switzerland.* *Per year Fr.* 12.50.

**Schweizerische Militärische Blätter.** *Monthly.*
*Frauenfeld, Switzerland.* [*S. M. Blaetter.*] *Per year* 12 *Fr.*
Includes:
**Monatschrift fuer Offiziere Aller Waffen.**
**Zeitschrift fuer Artillerie und Genie.**

## ITALY AND RUSSIA.

**Rivista di Artiglieria è Genio.** [*R. Artig.*] *Monthly.*
*Tipografia Enrico Voghera,* *Per year* 30 *L.*
*Via Astalli* 15, *Rome.*

**Rivista Marittima.** [*R. Maritt.*] *Monthly.*
*Economo del Ministero della Marina,* *Per year* 25 *L.*
*Rome.*

**Razviedchik.** [*Razv.*] *Weekly.*
*KoloKolwaia Ulitza, No.* 14, *St. Petersburg, Russia.*

**Voyennyj Sbornik.** [*Sbornik.*] *Monthly.*
*Madezhcdinskoi Dom. No.* 21, *Per year* 4.80.
*St. Petersburg, Russia.*

## HOLLAND AND SCANDINAVIA.

**Artilleri-Tidsskrift.** [*Art. Tids.*] *Bi-monthly.*
*Artillerigården Stockholm, Sweden.* *Per year, U. S.,* $1.75

**De Militaire Gids.** [*M. Gids.*] *Bi-monthly.*
*De Erven F. Bohn, Haarlem, Holland.* *Per year, U. S.,* $2.00

**Militaert Tidsskrift.** [*M. Tids.*] *Bi-monthly.*
*Copenhagen, Denmark.* *Per year, U. S.,* $2.50

**Norsk Artilleri-Tidsskrift.** [*N. Art. Tids.*] *Bi-monthly.*
*Christiania, Norway.* *Per year* $1.50.

**Norsk Militaert Tidsskrift.** [*N. M. Tids.*] *Monthly.*
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## SPAIN, PORTUGAL, MEXICO AND SOUTH AMERICA.

**Annaes do Club Militar Naval.** [*Club Mil. Nav.*] *Monthly.*
43 *Rua do Carmo, Lisbon, Portugal.* *Per year* $3.85.

**Boletin del Centro Naval.** [*Boletin.*] *Monthly.*
*Florida* 659 *Buenos Aires, Argentina.* *Per year* $\$^{m}/_{n}$ 11.00.

**Liga Naval Portuguesa,** [*Liga Nav.*] *Monthly.*
6 *Praça Luiz de Camoes, Lisbon Portugal.* *Per year* $4.50.

**Memorial de Artilleria.** [*M. de Art.*]. *Monthly.*
*San Lorenzo* 5, *bajo, Madrid, Spain.* *Per year,* $3.60.

**Mexico Militar.** [*Mex. Mil.*] *Semi-monthly.*
*Puente de San Francisco,* 12, *Per year* $1.50.
*City of Mexico*

**Revista Cientifico-Militar.** [*Cientifico.*] *Semi-monthly.*
5 *Calle de Cervantes, Barcelona, Spain.* *Per year* 40 *Fr.*

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| **Revista del Club Militar.** | [*R. Club Mil.*] | *Monthly.* |
| *Calle de Suipacha No.* 383, *Buenos Aires.* | | *Per year* $m/n 15.00. |
| **Revista de Engenheria Militar.** | [*Eng. Mil.*] | *Monthly.* |
| 27 *Rua Nova do Almada, Lisbon, Portugal.* | | *Per year* 16 *Fr.* |
| **Revista do Exercito e da Armada.** | | *Monthly.* |
| *Largo de S. Domingos* 11, | [*Exercito.*] | *Per year U. S.* $6.00. |
| *Lisbon, Portugal.* | | |
| **Revista General de Marina,** | [*R. G. de Marina.*] | *Monthly.* |
| 56 *Calle de Alcalá, Madrid, Spain.* | | *Per year* $4.45. |
| **Revista de Marina.** | [*R. de Mar.*] | *Monthly.* |
| *Casilla del Correo* 976, *Valparaiso, Chili.* | | *Per year* $10.00. |
| **Revista Maritima Brazileira.** | [*R. Marit. Brasil.*] | *Monthly.* |
| *Rua Conselheiro Saraiva n.* 12, | | *Per year* $6.60. |
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| **Revista Militar.** | [*R. Mil. Portugal.*] | *Semi-monthly.* |
| 262 *Rua da Princeza, Lisbon, Portugal.* | | *Per year,* $2.60. |
| **Revista Militar.** | [*R. Mil. Brazil.*] | *Monthly.* |
| *Rio de Janeiro, Brazil.* | | |

### UNITED STATES.

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| **American Electrician.** | [*Amer. Elec.*] | *Monthly.* |
| 120 *Liberty Street, New York.* | | *Per year* $1.00. |
| **American Journal of Mathematics.** | | *Quarterly.* |
| *Johns Hopkins University,* | [*Jour. Math.*] | *Per year* $5.00. |
| *Baltimore, Md.* | | |
| **American Machinist.** | [*Amer. Mach.*] | *Weekly.* |
| 256 *Broadway, New York City.* | | *Per year* $3.00. |
| **American Manufacturer and Iron World.** | | *Weekly.* |
| 55 *Ninth Street,* | [*Man. and Iron World.*] | *Per year* $4.00. |
| *Pittsburgh, Pa.* | | |
| **Annual of the Office of Naval Intelligence.** | | |
| *Washington, D. C.* | [*Naval Intelligence.*] | |
| **Army and Navy Journal.** | [*A. and N. Jour.*] | *Weekly.* |
| *New York City.* | | *Per year* $6.00. |
| **Army and Navy Register.** | [*A. and N. Reg.*] | *Weekly.* |
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| **Bulletin of the American Mathematical Society.** | | *Ten numbers per year.* |
| *University Heights,* | [*Bulletin Math. Soc.*] | *Per year* $5.00. |
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| **Cassier's Magazine.** | [*Cas. Mag.*] | *Monthly.* |
| 3, *West* 29*th Street, New York City.* | | *Per year* $3.00. |
| **Electrical World and Electrical Engineer.** | | *Weekly.* |
| 9 *Murray Street,* | [*Elec. Eng.*] | *Per year* $3.00. |
| *New York City.* | | |
| **Electrical Engineering.** | [*Elec. Eng'ing.*] | *Monthly.* |
| *Monadnock Block, Chicago, Ill.* | | *Per year* $1.00. |
| **Electrical Review.** | [*Elec. Rev. N. Y.*] | *Weekly.* |
| 41 *Park Row, New York City.* | | *Per year* $3.00. |

**The Engineer.** [*Eng. Cleve.*] *Fortnightly.*
*Blackstone Building, Cleveland, Ohio.* *Per year* $2.50.

**Engineering Magazine.** [*Eng'ing. Mag.*] *Monthly.*
120-122 *Liberty Street, New York City.* *Per year* $3.00.

**Engineering and Mining Journal.** *Weekly.*
253 *Broadway,* [*Eng. and Min. Jour.*] *Per year* $5.00.
*New York City.*

**Engineering News and American Railroad Journal.** *Weekly.*
220 *Broadway,* [*Eng'ing News.*] *Per year* $5.00.
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**The International Quarterly.** [*Int. Quart.*] *Quarterly.*
*Burlington, Vt.* *Per year* $3.00.

**The Iron Age.** [*Iron Age.*] *Weekly.*
232–238 *Williams Street, New York City.* *Per year* $4.50.

**Journal of Electricity.** [*Jour. Elec.*] *Monthly.*
421 *Market Street, San Francisco, Cal.*

**Journal of the American Chemical Society.** *Monthly.*
*Easton, Pa.* [*J. Chem. S.*] *Per year* $5.00.

**Journal American Society of Naval Engineers.** *Quarterly.*
*Navy Department,* [*A.S.N. Engrs.*]
*Washington, D. C.*

**Journal of the Association of Engineering Societies.** *Monthly.*
257 *South Fourth Street,* [*Eng. Soc.*] *Per year* $3.00.
*Philadelphia.*

**Journal of the Association of Military Surgeons.** *Monthly.*
*Carlisle, Pensylvania.* [*Jour. Mil. Surg.*] *Per year* $3.00.

**Journal of the Franklin Institute.** *Monthly.*
*Philadelphia, Pa.,* [*Frank. Inst.*] *Per year* $5.00.

**Journal of the Military Service Institution.** *Bi-monthly.*
*Governor's Island,* [*Jour. M. S. I.*] *Per year* $4.00.
*New York City.*

**Journal of the U.S. Cavalry Association.** *Quarterly.*
*Fort Leavenworth, Kan.* [*Jour. U. S. Cav.*] *Per year* $2.00.

**Journal of the Western Society of Engineers.** *Bi-monthly.*
1737 *Monadnock Block,* [*W. Soc. Eng.*] *Per year* $2.00.
*Chicago, Illinois.*

**Marine Review.** [*Mar. Rev.*] *Weekly.*
*Cleveland, Ohio.* *Per year* $2.00.

**Military Information Division.** [*Mil. Information Div.*] *Occasional.*
*War Department, Washington, D. C.*

**Mines and Minerals.** [*M. and Min.*] *Monthly.*
*Scranton, Penn.* *Per year* $2.00.

**Notes on Naval Progress.** [*Naval Progress.*] *Occasional.*
*Navy Department, Washington, D. C.*

**The National Guardsman.** [*N. Guard.*] *Monthly.*
134 *Van Buren Street, Chicago, Ill.* *Per year* $1.00.

**Pennsylvania Magazine of History and Biography.** *Quarterly.*
13 *Locust Street,* [*Penn. Mag.*] *Per year* $3.00.
*Philadelphia.*

**The Photographic Times.** [*Phot. Times.*] *Weekly.*
60 *and* 62 *E.* 11*th Street, New York City.* *Per year* $5.00.

**Physical Review.** [*Phys. Rev.*] 10 *numbers per year.*
*Cornell University, Ithaca, New York.* *Per year* $5.00.

**Popular Science Monthly.** [*Pop. Sc. Mo.*] *Monthly.*
72 *Fifth Avenue, New York City.* *Per year* $5.00.

**Popular Mechanics.** [*Pop. Mech.*] *Weekly.*
*Journal Building, Chicago, Ill.* *Per year* $1.00.

**Proceedings of the American Philosophical Society.**
104 *South Fifth Street,* [*Proc. A. Phil. Soc.*]
*Philadelphia, Pa.*

**Proceedings of the American Society of Civil Engineers.** *Monthly.*
220 *West* 57*th Street,* [*Proc. A. S. C. E.*]
*New York City.*

**Proceedings of the Engineers' Club of Philadelphia.** *Quarterly.*
1122 *Girard street,* [*Eng. C. Phila.*] *Per Vol.* $2.00.
*Philadelphia, Pa.*

**Proceedings of the U. S. Naval Institute.** *Quarterly.*
*Annapolis, Md.* [*Naval Inst.*] *Per year* $3.50.

**Review of Reviews.** [*R. of Rev.*] *Monthly.*
13 *Astor Place, New York City.* *Per year* $2.50.

**The Scientific American.** [*Scien. Amer.*] *Weekly.*
361 *Broadway, New York City.* *Per year* $3.00.

**Science and Industry.** [*Scien. and Indus.*] *Monthly.*
*Scranton, Pennsylvania.* *Per year* $3.00.

**Shooting and Fishing.** [*S. and Fish.*] *Weekly.*
293 *Broadway, New York City.* *Per year* $3.50.

**The Spanish War Journal.** [*Span. War Jour.*] *Monthly.*
320 *Indiana Ave., Washington, D. C.* *Per year* $1.00.

**Technology Quarterly.** [*Tech. Quart.*] *Quarterly.*
*Mass. Inst. of Tech., Boston, Mass.* *Per year,* $3.00.

**Telephone Magazine,** [*Tel. Mag.*] *Monthly.*
*Marquette Building, Chicago, Ill.* *Per year* $1.00.

**Transactions American Institute of Electrical Engineers.**
26 *Cortlandt Street,* [*Trans. Inst. Elec. E.*] *Monthly.*
*New York City.* *Per year* $5.00.

**Transactions American Institute of Mining Engineers.**
99 *John Street,* [*Trans. Inst. Min. E.*]
*New York City.*

**Transactions of the American Society of Civil Engineers.**
220 *West* 57*th Street,* [*Trans. A. S. C. E.*]
*New York City.*

**Transactions of the American Society of Mechanical Engineers.**
12 *West* 31*st Street,* [*Trans. A. S. Mech. E.*]
*New York City.*

**Transactions of the Society of Naval Architects and Marine Engineers.**
12 *West* 31*st Street,* [*N. A. and Marine Eng'rs.*]
*New York City.*

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| **United Service.** | [*U. Serv.*] | *Monthly.* |
| 49 *Wall Street N. Y. City.* | | *Per year* $3.00. |
| **Western Electrician.** | [*West. Elec.*] | *Weekly.* |
| 510 *Marquette Building, Chicago, Illinois.* | | *Per year* $3.00. |
| **World's Work.** | [*World's Work.*] | *Monthly.* |
| 34 *Union Square East, New York City.* | | *Per year* $3.00. |

## ARTILLERY MATERIAL.

Argentine artillery hand-book, (Manual del Condestable) projectiles, fuzes, etc.—**Boletin**, September, October.

On shrapnel.—**R. Mil. Brazil**, August.

Casting of a high explosive shell, (Isham).—**Amer. Mach.**, January 8.

Experiments on spiral springs.—**Trans. A. S. Mech. E.**, Volume 23.

Disappearing guns, (carriages).--**Scien. Amer.**, Supplement, November 15.

Carriage of 2.5-inch guns in Baluchistan on riding camels.—**Jour. U. S. I., India**, October.

Carriages for coast artillery.—**R. Maritime**, September.

Rules for keeping, storing and packing mixed explosives.—**Arms and Ex.**, December.

The temperature of combustion and other properties during combustion of the varieties of smokeless powder, in firearms.—**N. Art. Tids.**, 4th Hefte.

Powdered aluminum as an improvement in the composition of almost all explosives.—**Umschau**, December 20.

Powder works at Granada.—**M. de Art.**, October.

Classes of powders and their application for war purposes.—**M. de Art.**, September, October.

New explosives and smokeless powder in Italy.—**S. M. Blätter**, October.

Powder works at Fontana Liri.—**S. M. Blätter**, October.

Manufacture of guncotton charges at Stowmarket.—**R. Maritime**, November.

Erosion in guns.—**R. de Mar.**, November.

Mounting 28 cm. Krupp guns in the batteries S. Juliao da Barra and Bom Successo (defenses of Lisbon).—**Eng. Mil.**, September.

Coast artillery guns and carriages.—**R. Maritime**, September.

Fiske electrical system for laying guns.—**Boletin**, October.

New field guns for the U. S. Artillery.—**A. and N. Reg.**, November 15.

The field gun with recoil carriage and steel shields.—**Jahrbeucher**, October.

History of the question of protective shields for field guns.—**Armee**, October 31, November 7.

Krupp's experiments in regard to field artillery shields.—**R. Artig.**, October.

Question of the new Belgian field gun.—**R. Artig.**, October.

Development of the Krupp field artillery material, Model 1897.—**M. de Art.**, September, October.

The question of non-recoil guns in Germany.—**R. M. Etrang.**, November.

Protective shields.—**S. M. Blätter**, November.

Latest development of the Krupp field artillery material.—**S. M. Blätter**, October.

Krupp R.F. field gun, model 1902, long recoil on carriage.—**R. M. Suisse**, November.

General von Reichenau's 5 cm. field gun using explosive shell.—**R. M. Suisse**, November.
French field artillery material, 75 mm.—**R. Artillerie**, October.
New Italian field artillery, manual of fire.—**R. Artillerie**, October.
Question of field howitzers in Germany.—**R. M. Etrang.**, December.
Howitzers and machine guns, German army.—**A. Marine**, December 7.
New machine guns since 1900.—**A. S. M. Zeit.**, November 22.
Machine gun groups of the German army.—**A. and N. Gaz.**, November 22.
Tests against shields for field artillery guns.—**R. M. Suisse**, October.
The struggle against protective shields.—**Armee**, October 17.
Extract from report of the commission for testing the altered rapid fire field artillery material.—**N. Art. Tids.**, 2 and 3 Hefte.
War material at the Dusseldorf Exposition, 1902.—**Jahrbuecher**, October.
The gun in naval warfare.—**Scien. Amer.**, December 6.
Range of the 30-pdr., and 5-inch, English Q.F. guns.—**A. and N. Gaz.**, November 8.
Medium guns and howitzers.—**Jour. U. S. I. India**, October.
Firing of a 7.5-inch quick-firing gun.—**Page Mag.**, December.
Artillery practice at search lights.—**A. and N. Gaz.**, November 8.
Working loads for manila rope.—**Trans. A. S. Mech. E.**, Volume 23.
The defense of coasts; batteries and submarines.—**R. Maritime**, September.
Notes on artillery matters, Germany, Austro-Hungary, Bulgaria, United States, France, Italy, Russia.—**M. de Art.**, October.
Plan for the improvement of artillery projectiles and for conducting ballistic tests.—**Kriegstech.**, No. 9, 10.
Some requirements of modern construction of guns and weapons.—**Kriegstech.**, No. 10.
Projectiles in the navy.—**R. de Mar.**, November.
The John Cockerill works, Seraing.—**M. de Art.**, September.
Projectiles for illuminating purposes (night combat).—**Mex. Mil.**, September 1.
Charts of field of fire for permanent artillery positions.—**N. Art. Tids.**, 2 and 3 Hefte.
The new British one-man folding range finder.—**Scien. Amer.**, January 10.
Observation ladders for field howitzers.—**Wochenblatt**, November 12.
Range finders for field artillery on the field of battle.—**Wochenblatt**, November 29.
Artillery telemeter suited to the battlefield.—**R. Mil. Brazil**, October.

## AUTOMOBILES, BICYCLES, AEROSTATION.

The Paul-Lebaudy, (French) airship.—**Scien. Amer.**, November 15; January 10, 1903.
Study of the dynamics of free balloons.—**Genie M.**, October, November.
Ballooning in the Russian army.—**A. and N. Gaz.**, November 8.
Aeronautics and war.—**Eng.**, November 7.
The most successful airship ever built.—**Leslie's Wkly.**, December 4.
Aerodromes.—**Scien. Amer.**, Supplement, October 25.
The Langley aerodrome.—**Scien. Amer.**, Supplement, November 29; December 6.
The "Santos-Dumont No. 9".—**Scien. Amer.**, December 20.
Aerial navigation.—**Memoires I. C.**, October.

The Arnold system of electrical traction.—**Scien. Amer.**, November 15.

Oil motor cars of 1902.—**Eng.**, November 7, 14, 21 ; **Eng'ing**, November 7, 14, 21, 28, December 5.

Simms armored motor car and its use for the observation and protection of railway lines.—**N. Art. Tids.**, 2 and 3 Hefte.

Mechanical traction and its application to war purposes.—**Cientifico**, September 1–15, October 1–15, November 1.

Electrically driven cars on common roads.—**Eng'ing.**, November 7.

Two-cycle automobile engines.—**Scien. Amer.**, November 29.

The Charron-Girardot, and Voigt gasolene automobile.—**Scien. Amer.**, Supplement, December 20.

Leading types of 1902 French light-weight automobiles.—**Scien. Amer.**, December 27.

On the use of automobiles.—**Armee**, October 24.

Present conditions as regards the use of automobiles for military purposes. —**Int. Rev.**, Supplement 44.

Automobiles used in the German maneuvers, 1902.—**Int. Rev.**, November.

Report on war office motor lorry trials, England.—**Int. Rev.**, November.

## BALLISTICS.

The temperature of combustion, and other properties of our smokeless powder, while being consumed in our new fire arms.—**N. Art. Tids.**, 2 and 3 Hefte.

Artillery fire on ship-board.—**Boletin**, September.

Direct measure of pressures in bores of guns and in hydraulic recoil cylinders, using spring-pressure gauges.—**Notes Const. Ord.**, No. 84.

Efficacy of shrapnel fire.—**R. Artig.**, October.

The effect of shrapnel fire.—**S. M. Blätter**, October.

The computation of general range-tables and their use in solving problems in artillery fire.—**Mitth. Art. u G.**, No. 11.

Automatic correction for deflection and wind.—**R. Artillerie**, October.

Erosion in guns.—**R. de Mar.**, November.

New methods of armor plate making.—**Frank. Inst.**, January.

Penetration of field gun shields by 7.9 and 6.5 mm. guns (Ehrhardt).—**Armee**, October 31.

Guns vs. armor.—**R. Maritime**, October ; **R. de Mar.**, October.

Armor at the Dusseldorf Exposition.—**Schiffbau**, November 8; **R. Artig.**, October.

## CHEMISTRY AND PHOTOGRAPHY.

The use of potassium-chloride for the solution of steel in making the determination of carbon.—**J. Chem. S.**, November.

An automatic gas generator.—**J. Chem. S.**, November.

The rapid determination of carbon by combustion.—**J. Chem. S.**, December.

Chemical analysis in the test of materials (metals).—**Stahl u. Eisen**, December 1.

Electric blue-printing apparatus.—**Elec. Rev.**, November 22.

Photo-copying.—**Eng'ing**, November 21.

Automatic electric blue-printing machine.—**Amer. Elec.**, December.

Recent developments in coloring matters.—**Scien. Amer.**, Supplement November 1.

## DRILL REGULATIONS, MANEUVERS AND PRACTICE.

Target practice in the U. S. army.—**S. and Fish.**, November 13.

Maneuvers of the IV army corps.—**R. M. Suisse,** October.

Recruit school of balloonists in maneuvers of 1902.– **R. M. Suisse,** October.

A few words on the German maneuvers of 1902.—**Cercle**, October 25.

The French field artillery regulations, 1901.—**N. Art. Tids** , 2 and 3 Hefte.

Disembarking maneuvers, Austro-Hungary.—**Cercle,** November 8, 15.

Crossing the Aar at Murgenthal by a cavalry regiment.—**A. S. M. Zeit.**, October 18.

Siege maneuvers at Chalons.—**A. S. M. Zeit.**, October 18; **Armee,** October 10.

Maneuvers of the French hospital corps, 12, 17 and 18th army corps.—**A. Marine,** November 9.

Provisional instructions for German aeronauts.—**Cientifico,** September 1–15.

The school of the soldier.—**Quest. Mil** , September, October.

Drill regulations for infantry. Proposed changes made by the firing school. —**N. M. Tids.,** 10 Hefte.

Lord Roberts' fire training.—**N. M. Tids.**, 10 Hefte.

The training of the infantry recruit.—**N. M. Tids.,** 10 Hefte.

Position and aiming drill, U. S. army.—**S. and Fish.,** December 25.

The technical character of training formations for infantry.—**Jahrbuecher,** November.

The French autumn maneuvers.—**Jahrbuecher,** November.

The Fort Riley maneuvers.—**Jour. M. S. I.,** January, February.

Maneuvers on the Linth Kanal, 2 and 3 October, 1902.—**A. S. M. Zeit.**, November 1, 8, 15.

The Imperial German maneuvers.—**Wochenblatt,** October 22, November 1, 8, 22, 24, 26.

Notes on Danish maneuvers.—**Int. Rev.,** November.

The grand maneuvers of the French army, 1902.—**Wochenblatt,** November 5, 12; **A. S. M. Zeit.**, November 1.

Infantry firing practice.—**Belgique M.**, November 9.

The value of drill and its limits.—**Wochenblatt,** November 8 ; December 6.

Firing instruction at the Royal Military College.—**R. Mil. Portugal,** October 15, 31 ; November 15.

General Langlois and the 20th corps (practical field exercises).—**A. Marine,** November 23.

Swiss army maneuvers, 1902.—**Cercle,** November 15, 22, 29 ; **Wochenblatt,** December 3.

Authority of officers.—**A. S. M. Zeit.,** November 15.

Austro-Hungarian maneuvers, 1902.—**S. M. Blätter,** October ; **Wochenblatt,** December 10, 13, 20.

Maneuvers of the medical corps, France.—**A. Marine,** December 7.

Army shooting.—**A. and N. Gaz.**, December 6.

Exercises in crossing streams by swimming, Swiss cavalry.—**R. M. Suisse,** November.

The Imperial Austrian maneuvers.—**R. M. Suisse,** November.

Maneuvers of the three arms combined.—**Exercito,** November.

Grand maneuvers in Kursk, Russia.—**Int. Rev.,** Beiheft, 35.

Firing of a 7.5-inch quick-firing gun.—**Page Mag.,** December.

English field artillery training, 1902.—**Wochenblatt,** October 29.

Firing practice for the officers Italian field artillery.—**Int. Rev.,** November.

Field firing schools in 1902.—**Mex. Mil.,** November 1.

Balloons and guns (balloons for observation of fire).—**M. de Art.**, October.

Artillery in the recent army corps' maneuvers.—**R. M. Suisse**, November.

Considerations on artillery maneuvers.—**Jahrbuecher**, December.

Mountain gun trials and practice in Switzerland.—**Kriegstech.**, No. 9.

A necessary reform in the elementary instruction of mountain batteries.—**M. de Art.**, September.

Extract of report of maneuvers of the field artillery, 19 to 20 June, Norway.—**N. Art. Tids.**, 2 and 3 Hefte.

Field artillery exercises and drills, 1901.—**N. Art. Tids.**, 2 and 3 Hefte.

Machine gun groups of the German army.—**Cercle**, November 1-8.

Attack on a fortified field position with service ammunition.—**A. S. M. Zeit.**, October 18.

Russian naval maneuvers.—**A. Marine**, November 2.

U. S. naval maneuvers in the Caribean sea, 1902.—**U. S. Gaz.**, December 13.

Lessons and information furnished by the French fleet maneuvers.—**Int. Rev.**, Supplement, 44.

The combined maneuvers in the Adriatic.—**Int. Rev.**, Beiheft, 34.

The American combined maneuvers in 1902.—**Rundschau**, November.

Target practice at sea, U. S.—**R. Maritime**, September.

English naval maneuvers, 1901.—**R. Maritime**, October.

English naval maneuvers, 1902.—**Yacht**, December 6.

The German naval maneuvers.—**Yacht**, December 13.

The English naval maneuvers, 1902, in the mediterranean.—**Rundschau**, December.

The French submarine boat maneuvers off Cherbonrg.—**Rundschau**, December.

## ELECTRICITY.

The Rowland writing telegraph.—**Elec. Rev.**, November 15.

Uses and advantages of alternating currents for land telegraphy.—**Elec. World**, November 15, 22, 29, December 6, 13.

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The new cruisers, England.—**U. S. Gaz.,** November 22.
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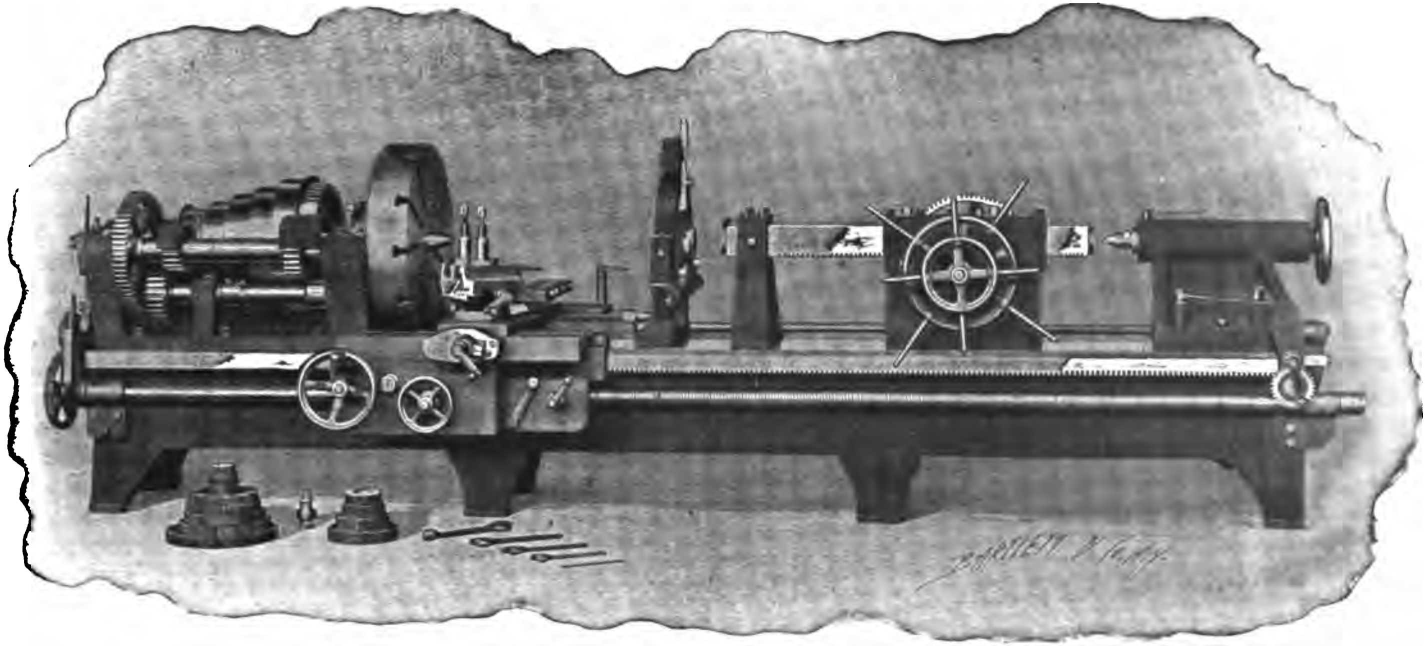

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MARCH—APRIL.

Vol. XIX. No. 2. Whole No. 60.

1903.

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JOURNAL

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VOL. XIX. No. 2. MARCH—APRIL 1903. WHOLE No. 60.

# COMMENTS CONCERNING THE REMARKS OF MAJOR WHISTLER UPON CAPTAIN HAAN'S REPORT ON FIRE CONTROL.*

BY CAPTAIN W. G. HAAN, ARTILLERY CORPS.

Major Whistler opens his remarks by saying, "My report * * * was not intended as outlining a system for adoption by others", and states in second paragraph, "It was to be expected that weak points would be found in the method, and it was for this reason that it was suggested that the method should be tested throughout the corps."

It was upon this "suggestion", made as it would appear by the author of the report, that it was, by direction of the Secretary of War, "published for the information and guidance of artillery officers, who will make a thorough test of the system during the approaching drill season, and at the end thereof report the result, with observations and recommendations, to the Adjutant General of the Army."

This left, to my mind, no other course than to try the system and report upon it, adding such observations and recommendations as were considered pertinent to the subject. "The importance of these considerations will, I hope, be accepted as an excuse for my going into the subject somewhat in detail" and for taking up the space I did in the *Journal*.

A copy of my report came into the hands of the staff of the *Artillery Journal* at Fort Monroe, which requested that the same be published. Such publication was not immediately authorized by the Secretary of War on account of an objection made, I was informed, by Major Whistler, until he could write a reply to be published in the same number of the *Journal.*

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* See *Journal of the United States Artillery*, November-December, 1902; vol. XVIII., No. 3.

Before making any comments concerning his remarks upon my report, I desire to call attention to a statement on page 11 of Major Whistler's report on "Fire Control, etc.," which I had previously misunderstood or I may mistake now. It reads as follows: "The result of this work (referring to work described in his report) was shown at the target practice, when two of the batteries each fired ten shots in less than thirty minutes, at a range of about 4500 yards, with Parrott ammunition, one of the batteries making ten hits or half hits upon the imaginary target". He does not state what the other batteries made.

To one studying this report, it is evident that the meaning conveyed by this statement is that these shots were fired at a moving target. I have been informed since that such was not the case. If I was correctly informed (and I should be glad to be corrected if I was not) that the firing was at a fixed target, it is absurd to say that any system of fire direction was used. It was a mere matter of correcting for error of previous shots and no set-back or predicted points were necessary.

During last year's annual target practice, two of the companies at this station fired at fixed targets with the 8-inch converted rifle. Each fired 10 shots; one company made 11 half hits and the other 9, and each series was completed in less than nineteen minutes; this when only about one hour's drill had been had at this class of gun by each company during the year; yet it was not claimed as something to vindicate any particular system of fire direction, because nothing but simple common sense was necessary. It may be added however that the guns were not fired by the indirect method.

If the remainder of the report is as lacking in clearness as this part, it is not surprising that it was not clearly understood by many officers who where directed to try it and report upon its merits.

It does not appear to me that the request that my report should not be published until he could write a reply, to be published in the same number of the *Journal,* is altogether a frank invitation by Major Whistler for the friendly discussion of a problem which is at present of vital importance to the proper development of our coast defenses. As for myself I am ready to accept any system that may be found to give the best results under circumstances that simulate as near as may be to those of an actual engagement, but I am not convinced that the theory of one officer should be accepted without trial or discussion, when that officer has had no experience in actual war and when his theories are contrary to the best judgment of a large majority of our artillery officers who have given this matter not only much thought but who have spent much of their time at the guns and have, therefore, studied the subject in as practical a manner as is at present possible in our service in time of peace.

While visiting Fort Wadsworth during the summer of 1902, I witnessed the drill with the indirect system; no observations were taken at signal "hit" to verify the correctness of the laying of the guns, and I was told by an advocate of the system that it could be practiced at fixed targets as well as at moving targets. I am now of the opinion that it would work even better at fixed than at moving targets.

To return now to Major Whistler's remarks: His statement that I did not understand the spirit of his method does not convert me to his way of thinking. I believe that I understood his report as it is understood by other officers who have given it a thorough test, and if that is not what was intended, there must evidently be a lack of clearness in the report.

I stated that it required four observations to make a prediction; I might have modified that perhaps by saying, "It takes four observations to make a prediction with some degree of accuracy". My plotter clearly understood how to use the auxiliary scale to make predictions from two, three, or four observations, but no degree of accuracy could be assured by the predictions from two or three observations. This follows naturally from the fact that for a three minute prediction from two observations, any error in observation or plotting either in range or direction would be multiplied by nine, and for a two minute prediction, by six.

It was found impracticable to make predictions for less than two minutes, because to get the data to the guns required on an average from 50 to 55 seconds. I am still of the opinion that two minutes is the smallest prediction practicable under the system.

It required more than three minutes, I might say, as a rule between shots "at drill", because the target had to be followed with the P.F. until "hit" was signalled, in order to get the distance to the target at the moment the shot would have struck had it been fired. This reading had to be taken and recorded and then the first observation for the next prediction taken on the next ring of the time interval recorder. It usually required approximately three minutes and twenty seconds. This of course would not be the case in action or practice, but only at drill, and my remark referred to the drill, so that in action the shots could be fired at about three minute interval, which for the 8-inch and 10-inch guns is about half the rate practicable.

I said in my report, "From the moment the shot is fired, it requires an entirely new set of observations to get data for another prediction". To this reply is made as follows: "This is not necessarily so. If the speed and direction of the vessel remain fairly constant, new prediction points can be determined without further observations." This condition however does not obtain in general, and my observations indicate that frequent changes in direction and speed would probably be made in a naval attack. On this very subject I have on various occasions talked to naval officers who have been in naval battles, and they invariably stated that changes of speed and direction would constantly be made with the view of avoiding predicted points. This was recognized long ago: for example, see *Journal U. S. Artillery*, April, 1894, page 195. Lieutenant E. M. Weaver, Artillery Corps, who appears to have been among the first who seriously advocated the use of a moving target at all times for target practice, and who has consistently worked on the same lines ever since, says: "But in actual combat the rate will be constantly changed by the captain of the ship being fired at, for the special purpose of making it difficult for the shore gun to hit the ship; (c) the direction of the ship is also difficult to determine even approximately and in combat it would be constantly changed. Instead therefore, of firing at a body moving in a straight line with a uniform velocity, we must be prepared to fire at one moving promiscuously in different directions and at varying velocities." Any system would work well "if" certain conditions always obtained, but the great "if" always makes itself prominent, and any system that depends upon the location of the "if" in a certain place will be sure to find it "dislocated" when it is most wanted.

"The astonishing errors in *azimuth* reported" can be accounted for in *three* ways: In addition to the two enumerated on page 293, *Artillery Journal*,* there is another one full of resource. At Battery Cranston the P.F. is 1200 yards to the left of No. 1 gun; suppose a vessel is 3000 yards away and coming directly toward the gun; refer to the figure:—

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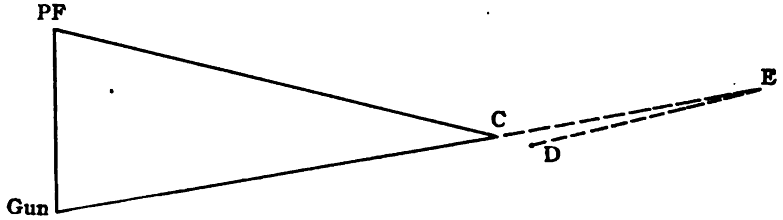
* November-December, 1902.

When vessel is at *E* a prediction is made say for *C* for which the gun is laid; now the vessel changes course very slightly to the left and crosses vertical hair when at *D*, and a miss in azimuth



is the result. Errors in azimuth are frequent when the P. F. is far to one side of the battery, as this system in its latest form contemplates, and reduces to a minimum when it is near the line of fire as at Fort Wadsworth.

The advocates of the indirect system would probably say that fire should be "held" in such a case as this, but with the Type "B" instrument, which is designated as the Battery Commander's instrument on medium and low sites, small differences in range are difficult to determine; but in any case, I found, with my Type "A" on a high site, that most of my commands at about the end of the predicted interval were, "hold fire," and "slowly but firmly" the conviction was forced upon me that this command would never destroy a fleet.

The officers understood the correct adjustment of the Type "A", and they did not "conceive the idea that the vessel was expected to reach the predicted point exactly at the expiration of the predicted time". In fact I claim for the officers and men of my company a fair amount of intelligence, and am satisfied that Major Whistler's report was fairly well understood by them.

In the discussion of the "fundamental, practical and tactical conditions, etc.," I desire to call attention to one point particularly. On page 296 we find: "It would be suicidal to adopt a system which expected the gunner (however well trained) who has never been under fire, to stand up on the sighting platform and give the proper allowance in the proper direction and to follow a vessel with cool deliberation, while under the fire of rapid-fire and machine guns and amid showers of pieces of exploding shells." On the same page he says: "It is in the actual run-by that rapid fire should be resorted to and then only within three thousand yards"; and on page 253 in "Tactics of fire direction",* referring to short range fire, he says: "Firing is done entirely by Case II. and the most rapid fire possible is used."

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* *Journal U. S. Artillery*, November-December.

In the indirect system, therefore, the change would take place and the gunner placed upon the sighting platform just at the time when rapid-fire and machine guns would become effective, and the poor gunner after all would have to stand "with cool deliberation" under "the fire of rapid-fire and machine guns and amid showers of pieces of exploding shells." A hard lot indeed, but why place him behind the parapet at long range when there is little danger, and expose him to panic at the moment when rapid-fire and machine gun fire from the fleet becomes effective.

In a small work at Sangly Point, near Cavite in Manila Bay, were mounted in a water battery, two 6-inch guns en barbette. They were manned by about forty Spanish soldiers. They received a heavy fire from Dewey's fleet at ranges varying from 6000 to 2000 yards, but these two guns kept up a continuous fire on the fleet until the *Petrel* turned their flank, thus taking them in rear. The guns were then abandoned and a detachment was landed which wrecked them. Both of the guns were in serviceable condition when they were abandoned. The officers commanding at the battery stated that they received a heavy fire but that none of his men were injured and that his guns were not silenced.

I am inclined to think that Major Whistler's fears for the gunners are much exaggerated and that the fire of a fleet would not be over accurate, especially if a heavy and rapid fire be received by it from the batteries on land; moreover it is my observation that in action men do not as a rule become excited but seem to be cooler even than usual.

I think the "fundamental, practical and tactical conditions" are exceedingly well stated in Major Whistler's remarks, but that they can best be fulfilled by the indirect system is, in my opinion, not made clear.

I do not wish to be understood as being opposed to all features of this system, and the very fact that an officer of as much experience and as good opportunities as Major Whistler has had, advocates it should carry much weight. His work in other lines has, in many cases, proven satisfactory and practical, but from that does not follow infallibility, and rather than discourage a friendly discussion of methods, it seems to me he should invite such a discussion. Nor does it seem that because he has placed himself on record as to his ideal system of fire control, this should preclude a discussion by him of other systems, for it is only by pointing out the weak points of any system that it can be made strong.

There is, to my mind, clearly a fundamental principle violated by the use of any system that makes the battery an adjunc tto the range finder. In any action I am satisfied that this would be reversed and that the battery must at all times be the main consideration and the range finder an adjunct. The work of the range finding detachment must, moreover, be done so quietly and perfectly as to allow, at any time it may be called for, the fullest development of fire by the battery, no matter whether at short, long, or medium range, and, in my opinion, any scheme that requires a change in the system of fire direction during an action is fatally defective. The more I work at the batteries and instruments with the instruction of enlisted men, the more I am becoming convinced that for high power guns the proper station for the battery commander is at the battery and not at the P.F. station, as was recommended in my report to which Major Whistler's remarks refer. A lieutenant can furnish to the gun commanders the predicted range each minute, just as well as the captain; and the captain, in his station at the battery or very near it, will be in a far better position to properly command and control it than at the P.F. station, unless the latter also is near the battery. No specific duty should be assigned to the battery commander, so that he may be free to direct properly the progress of the action and to carry out in detail the general instructions received from the fire commander.

Major Whistler correctly lays great stress upon the difficulty of working by synchronous time at two different places, but any problem of that kind becomes simple as it is studied, and already we have clocks that do this work for us without much difficulty. In the practice just closed in this harbor, no errors were made in time by the five high power batteries, all of which used the direct system, Case II., at "moving targets", making an average of 56½ per cent hits or "eleven half hits out of every ten shots"; but only five shots were fired in a series and all but one battery made excellent line shots. This practice was with a powder, untested, and supposed to give a velocity of 1300 f.s., while its calculated velocity, from data taken during the firing, was 1262 f.s. On account of interfering vessels and other causes, none of the series were continuous; Captain Koehler at the second shot hit the target and sank it, and had to fire the remainder the next day, when he got two more half hits. (Two half hits sound really larger than one hit, *ergo.*)

All the captains report the system in general satisfactory, but recommend some slight modifications, the necessity for which became very apparent during the practice and will be a matter to be taken up for correction in consultation with those officers who have worked most in this line.

It must be remembered that the communications and other arrangements at this station are very incomplete, and seem to have been materially delayed awaiting the test of a system now long overdue according to early promises but which, let us hope, may develop something of practical utility, and brush aside the objections in the way of communications and other necessities, whereby such an "effective" blockade has been established against our requests and requisitions.

I desire to hazard the suggestion that in attempting to correct for atmospheric conditions with the greatest refinement, we are too much carried away by theory. The most intelligent and most valuable men are taken away from the guns for this purpose. Economy in men is one of the first considerations in our service, and under no consideration should men be assigned to extraneous duties where the work done by them does not add to the "practical efficiency" of the battery. It does not seem to me justifiable to assign men for this purpose, except at stations where great changes of atmospheric conditions are to be expected, and is unnecessary work, for example, at most of the stations on the Pacific coast.

It has been my observation in all target practice that I have witnessed that the errors due to the powder and other unknown causes were very much greater than the corrections made for atmospheric conditions, with the result that these additional corrections had to be made, still further complicating the work.

Take for example the powder used in the target practice just closed at the Presidio, California, and of which a brief resumé is given below. At four thousand yards the range given by the powder was 170 yards less than theoretically it should have been had the powder given the velocity marked on the charges. The correction for atmospheric conditions was 9 yards. Had no corrections been made for atmospheric conditions, the shot would have in this particular case been 179 yards short instead of 170, and the correction for error of previous shot would have been quite as simple had no correction for atmospheric conditions been made. The chances are even that the actual error would have been less. In the second shot with the 10-inch disappearing guns, an error was made in laying the gun for elevation. This was due to two causes: "a", the elevation for a fictitious range about 170 yards greater than the actual range had to be taken from the table, causing double mental calculation, first for increase in range due to gun difference, and second due to slowness of powder; "b", conversion of yards of range into degrees and minutes of elevation, making three operations in a time too short for accuracy in rapid firing.

Of one thing all may rest assured, and it is that sooner or later, and the sooner the better, we will have to simplify our fire control and fire direction system to the utmost practicable limit. We must learn to manage this part of our work with the fewest trained men and instruments of precision that successful practice will justify. The very first step in this direction is to weed out in the chain of men and instruments, all whose work can not be demonstrated to be necessary, and which does not go straight and in an important manner to aid in landing the projectile on the target. This subject in connection with the proposed omission of atmospheric data in ballistic calculations is one which it is hoped will receive the careful consideration of the Board recently appointed for the the revision of the Coast Artillery Drill Regulations.

It cannot fail to impress itself upon any careful officer who has to instruct enlisted men that there is now, with rapid firing heavy guns, a prime necessity for an elevating device that reads in the same unit as the range finder. The necessity of conversion from yards to degrees and minutes gives rise to innumerable errors in practice and action, with a consequent inaccuracy the causes for which will be overlooked. The result is incorrect laying and confusion for succeeding shots.

I am of the opinion that the elevation device should be graduated in yards for each established velocity, and there should be an adjustable zero indicator so that when powder is tested and found to give a different velocity from that prescribed, a mechanical correction can be made by the adjustable zero indicator, and no double mental calculations and conversions will be necessary.

It may be said that a slight change in velocity from that for which the scale is constructed would render useless this scale, but such is not the case. By constructing velocity curves, especially for the service velocities, it is found that they are practically parallel for velocities varying as much as 200 f.s. By the use of a movable zero indicator we perform mechanically the operation of bringing these curves together at one point, say a mean range, and then they will coincide throughout near enough for all practical purposes; so that one elevation scale plate may be used for velocities say from 1800 f.s. to 2200 f.s. with practical accuracy.

As above indicated, the powder did not give the velocities marked on the charges. The result was that the first company firing was placed at a great disadvantage in being obliged to use a range table that was constructed for a different velocity and with no time allowance for even one careful observation.

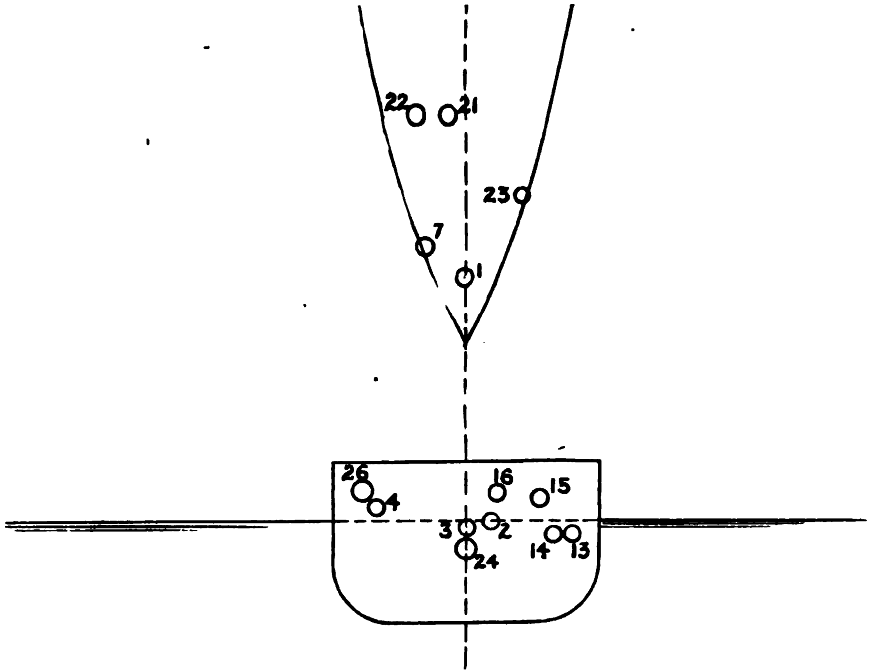
In this connection I desire to call attention to the following extract from the minutes of the Artillery Board at Fort Monroe, which extract was published in the *Journal U. S. Artillery* for November and December, 1902. "Extract from minutes of July 15. **The Artillery Board * * * desires to submit the following:**

"**The artillery makes no attempt to prescribe what muzzle velocity a powder shall give for a service charge, asking only** that it be as high as possible, but, the muzzle velocity being fixed on, the Board submits that the artillery should still be authorized to determine by test whether the muzzle velocity of the powder supplied is as stated."

The muzzle velocity of the powder furnished for this practice was marked on the charges to be 1300 f.s., but as a matter of fact it was nowhere near that velocity.

The companies in this harbor have just completed the practice with the ten and twelve inch guns; five companies firing. Two companies used the 12-inch barbette, two, the 10-inch disappearing and one, the 12-inch disappearing guns. The last, owing to some defect apparently in counter recoil buffers, did not function properly and the series could not be completed.

The ranges varied from 3100 yards to 5100 yards. Practice charges, smokeless powder, were used with service cast iron projectiles. The average percentage made, of the twenty-six shots fired, was 56½ per cent hits or a little more than 11 half hits for each ten shots fired. One company, Captain Cloke, with the 12-inch barbette guns made 100 per cent. This company had an advantage in firing last, and thereby knowing the slowness of the powder, which, it may be added, gave remarkably uniform results throughout the practice. There were a few erratic shots which were evidently due to other causes. Had the powder been tested, there seems no reason why the percentage of hits should not have been even better.



All the firing was done within the time limit as prescribed in General Orders No. 97, Adjutant General's Office, 1902.

The companies firing with the high power guns used the system of fire direction outlined in my report—in some cases, with slight modifications. These, where found more practical after further trial, will be included in a revised edition of the drill.

It does not now appear that any of the officers recommend any material changes in the system.

# THE FIELD ARTILLERY OF THE ARTILLERY CORPS.

BY MAJOR A. D. SCHENCK, ARTILLERY CORPS.

In Captain Coe's admirable article on Coast Artillery Organization,* he naturally has nothing to say respecting the field batteries, which now form an incongruous part of that corps, for, as a matter of fact, these batteries do not properly, and should not in any manner have any connection with a corps of artillery organized for coast defense.

To use one of the Captain's expressive terms, field artillery does not *fit* in anywhere in a proper organization for coast defense. It is possible that field artillery might be necessary to aid in the defense of some element of our coast defense, threatened by an enemy's attack by landing parties of greater or less force, but in such event it is quite evident that the field artillery would have no more to do with coast defense proper, than would the infantry or cavalry commands to which it is attached and of which it forms a proper and integral part. In fact the Captain clearly intimates that the infantry will necessarily have a very much more intimate connection with the coast defense, as guards within its works, than the field artillery will or can ever have, and, therefore, it would be much more appropriate to have thirty companies of infantry incorporated as a part of the artillery corps, than it now is to have thirty field batteries; yet no one has made even a suggestion for such an absurdity.

Field artillery is just as much a part of a field army as is infantry, both may be called to the defense of our seacoast works, but this involves neither necessity nor reason for making either field artillery, or infantry, or cavalry a part of a coast artillery organization.

It is a self-evident proposition that the field artillery should be entirely segregated from the coast artillery, as the two are widely different in their organization, instruction and purposes, and excepting the name "artillery" they have nothing more in common, than have the infantry or cavalry with coast artillery. If now this separation can be done without at the same time reducing the numbers of the officers and enlisted men now provided by law for the artillery corps, the corps will at once practically secure an increase in its available personnel, of about 135 officers and 3600 enlisted men, of the 367 officers and about 6000 enlisted men, which Captain Coe shows to be an absolute necessity *now;* and in doing this, attention is particularly called to the fact that he has not taken into account at all the most urgent necessity of the coast defense—that of the submarine mining, (including submarine torpedo boats), which calls for a minimum force of over 100 officers and 3000 men, and the corps will still be short 232 officers and over 2000 men. To this total for actual service at stations, must be added at least 5 per cent of the number of officers on account of absence by detail, leave, sickness, etc., and to the enlisted strength 3 per cent for normal sick, 4 for guard duty, and the per cent authorized by army regulations to be absent on furlough. It will then appear that the number of men actually required to man properly the coast armament already completed and ready for use, (*one* relief, it is not worth while considering more now, save for a few of the most important stations, where two or three reliefs are obviously necessary), is 951 officers of various grades up to and including a major-general commanding, (as in the Marine Corps, with scarce half the personnel, and none of the armament, or the navy with about the same number of men and much less armament, and 18 major-generals), and 27,237 enlisted men; just about what was predicted ten years ago would be required about this time.

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* *Journal of the U. S. Artillery*, January-February, 1903.

It is thus seen how urgent is the need of the artillery corps proper for an increase in its personnel, and why the detachment of the field artillery therefrom in the manner indicated, would afford great relief, and would be an exceedingly wise measure for the increase of the strength and efficiency of the corps without calling special attention thereto at the present time, when we are in danger of having trouble with one or more great military powers. If the field artillery be given a proper organization at the same time, it need be no reason for foreign comment, as such an organization for the present would have to do only with batteries already in the service.

Having separated the thirty field batteries from the artillery corps, thereby enabling it to pursue better its proper sphere of work, what is to be done with the batteries? Are they still to remain without any legal organization whatever higher than that of a battery? In the army of every civilized country in the world the field artillery forms as much an integral part thereof as do the infantry or cavalry, and is organized into battery, battalion, regimental and brigade units, just as those arms are, but as a matter of course, and for reasons too obvious to require mentioning, these units in the artillery are widely different in the details of organization, from those of the other arms. These organizations are found in Germany, France, Russia, Austria, Belgium, Holland, Italy, Spain and even in Japan. In England the general form is followed to a considerable extent, but the organization is poorer than in any country named.

The organization of a battery is peculiar to itself, and is based upon purely artillery conditions. Not so the higher units however. These depend for their strength directly upon the divisional and corps organizations of the infantry, or of the cavalry. The fact that we have no division and corps organizations is no more reason for not giving the field artillery a proper organization, than it would be to have no officers in the army of higher grade than colonel of a regiment. Regiments of field artillery are as much required for war service as are infantry regiments, and as we do not wait for war to organize the latter, neither can we wisely and safely do so for the field artillery.

To each division of infantry or cavalry is assigned a battalion of 3 or 4 light field, or horse batteries; the divisional battalions of an army corps forming a regiment. To each army corps is assigned 2 or 3 battalions of heavy field batteries, and sometimes another of horse artillery; which constitute the regiment of corps artillery, the two regiments of the corps forming a brigade of field artillery, under the corps chief of artillery, who may be a brigadier, but is generally a major-general of *artillery*. At the same time peace conditions are prescribed for a less force than when on a war footing, and provision is made for the cadres for the ammunition trains (in many instances the artillery is charged with the infantry ammunition also). Nominally the brigade is the highest unit of the organization. But, as in the Franco-Prussian war, when three German armies were in the field under the command of the old Emperor William, huge bodies of artillery from two armies were combined under the command of the superior artillery generals, or under the supreme chief of artillery on the staff of the Emperor. So that, although the regular organization only includes the brigade, it is supplemented, or completed to any necessary or desired extent for battle purposes in the persons of the generals who comprise the superior artillery hierarchy, who are the chiefs of artillery of the various armies, and that of the entire army as a whole.

The details of all this as applicable to our own army, and its necessities, are worked out very completely, and shown in a bill, H.R. 15446, introduced in the present session of Congress by Mr. Esch. See *Journal U. S. Artillery*, July-August, 1901.

As a matter of course there must be provided, in addition to the horse, light and heavy field artillery which is always intimately connected with armies, whether in peace or war, mountain artillery, just as we now have, but which we should have had before our army went to Cuba in 1898. Provision must also be made for siege artillery, for the personnel of the siege trains of armies, or for the garrisons of field fortfications as used in war. If one will scan a map of our northern frontier and study its military features, lines of communications, etc., along or intersecting, it will be noted that we should at present have from 6 to 10 regiments of siege artillery alone, depending upon the size and number of battalions assigned to a regiment: 1—Calais, Me., 1 regiment. 2—Platsburg Barracks, N. Y., 1 regiment. 3—Buffalo, N. Y., 1 regiment. 4—Detroit, Mich., 1 regiment. 5—Sault Ste Marie, Mich., 1 regiment. 6—Pembina, N. D., 1 regiment. 7—Shelby Junction, Mont., 1 regiment. 8—Old Fort Mackinac, Mich., 1 battalion. 9—Isle Royal, Mich., 1 battalion. 10—Boundary, Wash., 1 battalion. 11—New Whilcome, Wash., 1 battalion, and even this summary takes no account of one of the most important of all points, *viz.* the south bank of the Saint Lawerence River, in New York state. Whether for defensive or offensive purposes on our part, beyond any question of doubt these, as the most important points, should be at this present time provided with adequate garrisons of siege artillery fully equipped, and most if not all of them should be provided with complete systems of field fortifiations. The coast artillery has no part in this. It falls within the siege branch of the field artillery to defend such fortifications if attacked by our enemy, and where mobility enables it to advance with our army if we take the offensive. It will hardly do for us even to think of trouble with England and Germany with such a remarkable frontier as this utterly undefended, and no provision made for defending it. It is probably the most remarkable military frontier in the world, with the Saint Lawrence and part of each of the Great Lakes in the hands of our possible enemies, and extending to the heart of the continent.

When it comes to the organization of the field artillery, it must be thoroughly recognized that there are battalions and battalions. We had some years ago an effort to "assimilate" the drill manuals of the three arms, wherein 4 companies, troops or batteries constituted a normal battalion; without any consideration as to their real relative values, all were placed upon the same footing, under the command of a single field officer, and he, a major. If this be correct then is the lieutenant-colonel properly organized out of a necessity for existence. But it is not right. The lieutenant-colonel has been the proper battalion commander ever since the perfection of the Greek phalanx twenty-five or more centuries ago, and the major was his supporter, his "marshal of camp", his executive, summary-court officer, etc., for it was recognized, perhaps long before that time, that it was neither just nor wise to have a captain try his own men and those of other captains in his own battalion for certain military offenses.

What the relative value of these battalions is, even under a given set of circumstances is indeterminate. A battalion of field artillery on a war footing will easily "size up" with a regiment, and perhaps a brigade of infantry at its full strength. The average man will no doubt at once seek a solution of the question by demanding the money value of each in coin of the realm.

A battalion of field artillery (even exclusive of the battery of the train), costs, for its equipment, etc., more than $340,000, while the similar cost of 3 battalions of an infantry regiment of 1800 men is less than $40,000. Measured by this commercial standard the artillery battalion is more than an equal of 25 infantry battalions, or 8 regiments, with 40 field, and 64 staff officers. Our present so-called "provisional" battalions of field has *one* temporary field officer, and no permanent staff officers or non-commissioned officers at all. Not by any means even suggesting that the infantry organizations have more than they ought to have, for they have not, but are properly organized under present conditions of warfare; excepting that they too ought to have a lieutenant-colonel to command the present much larger battalions than were contemplated in the old drill manuals.

A much more rational measure of value would seem to be the relative fire areas swept over by the respective arms turned through an arc of 180°, by changes of front, etc. The maximum effective range of the musket is 2000 yards; that of the artillery shrapnel is 6500 yards (for shell this range is 7500). The fire areas vary as the squares of their radii, or as 4 to 42½, in favor of the artillery. But as we are also trying to get some valid measure of the relative importance of these organizations as military commands, and the difficulties incident to command, administration, instruction, etc., in order to account for the difference in the field and staff, and non-commissioned staff assigned to a battalion of artillery, let us consider the men of the infantry battalion, and the men and horses of the artillery; always remembering that a horse cannot in anywise take care of himself and gives far more trouble than a man, yet at the same time that the mobility of the artillery and its power to get into battle at all depends entirely on the horses. The infantry battalion numbers 600 men, that of the artillery 700 men and 600 horses, 1300 in all. A difference of more than 2 to 1 is evident from the mere numbers, but these have by far the least significance. The ration for a man weighs in bulk about 4 pounds, and the artillery has more men by 100. But the forage ration for a horse weighs 26 pounds, and a day's forage for the artillery battalion weighs more than the rations of two regiments of infantry. The service of the artillery involves an immense amount of care and repairs of saddlery, harness, and a large list of other things including the guns, carriages, and a large, valuable and exceedingly important supply of ammunition. These are some, (but quite a sufficient number apparently), of the reasons why the regimental and battalion staffs, should differ materially from those of the infantry. The conditions are altogether different, and the organization must *fit* the conditions if efficiency is to obtain.

Respecting instruction; besides that pertaining to his own special arm, the artillerymen has also to learn a very large part of that pertaining to both the cavalry and infantryman. Finally, the drill and tactical conditions of service and battle formations arbitrarily demand at least two field officers with each battalion of field artillery, and naturally the senior should be senior in grade, and not merely the senior in rank in the same grade; otherwise there is no sense in having 3 grades of field officers in a regiment of any kind—all would be majors with the senior in rank in command; the absurdity of which will at once be apparent even to the non-military man.

From the extremely intricate nature of the material and of the personnel and its multiform duties, and their uses in peace and war, it is very much more necessary that the field artillery should be more perfectly and completely organized than either infantry or cavalry. We find that it is so in every foreign army, and among military experts the reasons therefore are so many and so obvious that it is hardly considered necessary to enumerate them.

When we get the proper organization for field artillery, the uniform question, at least for full dress, should at the same time be settled once for all, by giving to the first five regiments the full dress prescribed for the five regiments authorized December 12, 1776; for the sixth regiment, that of the regiment authorized April 12, 1808, and so on down through the history of the field artillery; the uniform to include if you please white wig, knee-breeches, buckles, silk stockings and all, for the dismounted ceremonies. The uniforms would not only be handsome but also, and what is far more to the point, they would be historic—American, and should never be changed; whereas the service uniforms may be left to the mercy of the uniform crank and his tailor.

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A few words may perhaps be permitted upon the subject of Captain Coe's article. It seems a strange thing that we hear so much respecting the organization of the coast artillery, and have not in all our history heard anything respecting the organization of the personnel of the navy; that so many artillery officers cannot seem to grasp the fact that organizations of battery, battalion, regiment, etc., pertain only to field artillery, and not one of them *fits*, or finds any proper application in coast artillery.

Nelson's flagship the *Victory*, 100 guns, with a thousand or more men, represented by far the most complicated, and at the same time the most perfectly and completely organized fighting machine the world has ever seen, nothing pertaining to coast artillery even nearly approaches it in comparison. Yet while we have endless pipe dreams as to the organization for the latter, we can find not a word respecting that for ships, further than to be handed a simple *Station Bill.* All that is necessary is for the commander of a fort to do just what Captain Hardy or his predecessor had done for the *Victory*—make out the station bill to fit that particular ship, assign the men to their respective places, and the organization was completed in the most perfect manner, just as it would be in any fort. The armament of the latter would naturally create "divisions" which would fall to a captain's command, with all of its necessary personnel and material, and so for submarine mines, communications, etc., the whole forming the garrison of that particular fort only, but which would probably not *fit* any other fort on earth, just as the crew of the *Victory* probably would not have fitted any other ship in any navy.

The drill manuals and regulations prescribe the stations of every man necessary to the defense of a fort, and every one of them can be plotted upon the plan of that fort, and the necessary officer or man assigned to it, and if there be not enough to go around, the plan will show to a man just what the shortage is. This plan can be sent to the War Department, bound up with those pertaining to the rest of the coast defense, sent to Congress and it will then have a graphic representation of just what the Nation has and just what is required to the last man, and which a child could understand with scarce a word of explanation.

The Station Bill then completes the organization for any fort or battery whatsoever, and at the same time inevitably wipes off the slate all of the 126 companies of the Artillery Corps. When the War Department has revised, corrected and totaled the various station bills, details, etc., there will be found about 951 officers, and 27,237 enlisted men, called for from Congress as follows: "1 Major-general commanding, 6 brigadier-generals, 21 colonels, 47 lieutenant-colonels, 98 majors, 286 captains, 263 first lieutenants, 229 second lieutenants and 27,237 enlisted men to be rated for rank and pay as the President may direct". We should have then practically what they have in the navy. When the station bill of a fort called for an electrical expert, a first sergeant, sergeant, corporal, first-class private or private, the President would give the necessary order and the thing is completed.

For administrative and like purposes, the fort commander would provide for the necessary staff; adjutant, quartermaster and commissary, ordnance officer, etc. The muster rolls. descriptive books, etc., of the present companies would be turned in to the adjutant, quartermaster papers to that officer, etc., and so for each administrative department. All of the men would become members of the garrison of Fort———, and would there serve their enlistments. If a man upon discharge, has a character "excellent" (or very good, say), he ought to have the privilege to re-enlist here, to serve in any garrison he may choose (perhaps within certain geographical limitations). He gets his order from proper authority, goes to the quartermaster for his transportation, packs his grip and, being a reliable man, in due time turns up at his proper station and reports for duty. There will be no more transporting of batteries from the South to the North, from the Occident to the Orient, together with cart loads of old records, libraries, and plunder without end.

The old books will remain where they now are (the Adjutant-General being notified just where those for any particular company are), until the hypothetical New Zealander digs them out of the ruins some centuries hence, as evidences of how much we did not know, or at least did not practice, in the so-called organization of coast artillery in these dark ages.

When a soldier who has not the necessary character to entitle him to change station, has been found by the surgeon to require climatic change, he can be ordered anywhere for the purpose, but at the discretion of the powers that be, not his own. Officers will change through promotion, or as the authorities see fit when necessary.

The muster roll of the garrison will be made out by the adjutant, taking the divisions, companies, or whatever a captain's command may be designated in orders, in any designated order on the roll. The other staff officers will perform all of the administrative duties pertaining to their respective departments; captains giving only memorandum receipts, etc., and making no returns, but making out morning, and other reports as to the personnel comprising their respective commands. Should this garrison have to parade for show, it is formed up, the adjutant equalizes the line into a battalion, or battalions of so many companies, assigns the officers and guides, and the command is ready.

As already indicated, the station bill completed in men will *fit* any and all kinds of coast fortifications, just as in the navy it fits any kind of a vessel from a tug to a battleship, and what is still more to the point it gives exactly the best, and in fact the only "organization" required for any defense or requirement whatever; there may be a dozen or more captains commanding 10-inch gun batteries, under varying conditions scattered along the coast, and no two of these commands may be alike in personnel, and it is not of the slightest consequence whether they are or not.

It is clearly apparent that it is just as necessary to wipe out the present arbitrarily organized companies of coast artillery, as it was the old regiments. These organizations belong to field, not to coast artillery, and should be applied properly where they belong.

The various fort commanders and their station bills will provide all the "organizations" required, and in the best possible manner.

At the present writing, (February 1, 1903) owing to the troubles in Venezuela, it is very evident to the minds of many in authority, that the personnel necessary to fill the station bills properly and completely for our various coast fortifications should have been authorized some time since; especially for the submarine mine, and torpedo boat defenses, which come first in harbor defense, requiring as a minimum over 100 officers and 3000 men, but for which we have scarcely a single officer or man qualified for the work.

Finally, is the defense of our coast of so little consequence, and the work of the officers charged therewith worthy of so little consideration and reward, that none may look for a higher grade in promotion in the service on the active list after perhaps forty years of faithful service, than that of colonel? The coast defense stands upon certainly an equal plane with the navy as a secure defense, not alone of the coast but of the navy itself in many an hour of need. The navy, with scarcely more men than the Artillery Corps now has, is authorized by law to have 18 officers with the grade of a major-general. It certainly can not be considered unreasonable to give the corps one officer with that grade, and one-third of the number in the navy, with the next lower grade.

As a matter of fact these grades are not required for rewards to anyone, but to complete the corps, for its command and for the commands of its chief subdivisions, and to act as inspectors for the whole. They are just as necessary to insure the efficiency of the coast defense, as are the rear-admirals to insure the efficiency of the navy.

# THE ARMY AND NAVY MANEUVERS AS VIEWED FROM AFLOAT.*

By Lieutenant-Commander ROY C. SMITH, U. S. Navy.

The writer of this article does not propose to describe the maneuvers. Accompanying the paper is Admiral Higginson's Bulletin giving a summary of the movements of the fleet, and a sketch-map showing the approximate paths of the ships in the more important engagements.

There was, however, among the officers taking part afloat a consensus of opinion on various points that came up, which may prove of interest; and it shall be the endeavor of the writer to summarize these views to the extent that they became apparent to him.

The rules were criticized in a number of particulars by officers of both services. Prior to the maneuvers the two officers who had prepared the rules, under the direction of General MacArthur and Admiral Higginson, met the umpires and observers to talk over the subject and settle any doubtful points. At this conference the discussion turned about three principal questions. One was whether the life of the defensive works had not been somewhat underestimated, another was as to the course of proceedure in the event of disputes of umpires in the few cases where under the rules decisions were required, and another was as to whether it was advisable to assign any values to gunfire and the life of ships and forts. The discussion was amicable, and of course it was too late to make any changes, but one of the officers present remarked that had the Lord's Prayer been up for discussion it would not have fared any better.

In regard to the questions mentioned, it is pertinent to state that they had been considered by the officers who formulated the rules. The War College staff had, unofficially, rather deprecated assigning values to gunfire or the life of ships and forts. Their argument was that it would result in laying down all the moves on the game board and counting points, rather than in acting in accordance with judgment and as circumstances should dictate. This would have been in a sense objectionable; still any commander planning an attack would naturally count up the opposing forces and estimate how long he would be under fire, and would endeavor to form in his mind some estimate of the damage to be expected. Also, one of the features of the maneüvers was that no units were to be declared out of action during any engagement, but for the sake of the training and experience were to continue through to the end, the Board of Arbitration deciding finally as to the outcome.

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Hence some method was required by which a responsible commander could estimate approximately when to cease his fire on certain ships or batteries and then turn his attention to other units as they arrive in his field. Some such assignment of values would have to be made use of by the Board of Arbitration in arriving at their conclusions, and it seemed fair that if it was to be used at all it might as well be public to everybody.

One of the other questions related to the accuracy of the assigned values. No artificial rules could replace actuality. The most that could be done was to devise a method of approximating average values in these, the first combined maneuvers, and then to correct the values in the light of the experience gained. Quoting from an article by the writer in the *New York Independent*, the method was something as follows: "A battleship was given arbitrarily a life of 1000 points. It was asumed that one or two 12-inch shells loaded with maximite and penetrating her vitals would put her out of action. Then from the accuracy of fire at different ranges and the angle of fall, the number of shots was estimated that would have to be fired to get two into the vitals of the ship. The quotient of 1000 by this number was the value of each shot of a 12-inch army gun at the stated range. And so for other guns and and other ships than battleships. The points for the navy guns followed in this wise. At close ranges their accuracy is practically the same as for the corresponding army guns. At extreme ranges, owing to the instability of the gun platforms, and the circumstances that there are no accurate means supplied aboard ship of getting the range, as there are on shore, the percentage of hits will fall considerably below that of the army guns at the same range. This is not a criticism of the ship. Ships are meant to fight each other at ranges close enough to produce results. Then the size of the vulnerable target, whether battery, or position-finder or searchlight, as affected by the angle of fall of the projectile, and as compared with the average target presented by a battleship, and the damage done by one hit of a given caliber, determined the points to be assigned to each caliber for each range, and the life in points of each object fired at. It is to be understood that the points assigned the army and navy guns at the various ranges were in no sense a comparison of the guns themselves. The points had nothing to do with the relative power of the guns, but were the estimated effect of their fire in points *against the life of their own targets.* There was also established a rate of fire per minute supposed to be adequate to silence temporarily the batteries on shore and the exposed guns of the ships."

While on the subject of the rules it may be as well to indicate the changes which, in the opinion of the writer, the experience of the maneuvers showed to be desirable. It would be well to limit the effect of the lighter caliber fire to silencing only, and not to count it at all against the ultimate life of the various targets. Under the rules it counted against the life of ships and batteries when used in co-operation with higher calibers. It would be better not to count it at all except in silencing. The total points from a 6-pounder at 500 yards are 200 per minute, whereas from a 13-inch gun they are only 100 per minute. Hence a 6-pounder would have more effect against a defensive work, both firing together, than a 13-inch gun, an anomaly that may be corrected in the manner suggested; that is, count the 6-pounder only in silencing, the 13-inch gun both in silencing and destroying.

The searchlights and position-finder towers were found to be much more conspicuous than the rules seemed to contemplate, hence their life in points would apparently need to be diminished.

Some ambiguity seemed to exist as to the limits of phases in the various operations. As no ships or forts were to be ruled out during the maneuvers, the navy tacitly assumed that their whole force was available for any attack that might be made; whereas the army apparently assumed that certain ships had been destroyed in earlier phases and hence were negligible in later phases. It would be well hereafter to make the meaning perfectly clear in this regard and to adopt some readily understood signal to indicate the beginning of a new phase. Rule 57, in reference to attacks on intrenched positions, contemplated shore operations only, and not landing parties supported by the fire of ships. The following sentences might be added: "In the case of an attack by a landing force supported by the fire of ships, the advantage in favor of the defense shall be reduced, or reversed, in such manner as the umpires may decide to be reasonable. In case of a failure to agree, the circumstances shall be referred to the Board of Arbitration."

It was suggested, and it is to be hoped that the suggestion was accepted, that the Board of Arbitration amend the rules in the light of all the various reports, and thus leave on record a basis to start with in case something similar has to be done in the future; in other words to thresh out something practicable by the trial and error method. One of our navy faults is to try nearly everything *ab ovo*, instead of gradually building up a method in particular cases that shall be in course of time at least partially self-working.

In arriving at any useful results in maneuvers of this kind, it must be borne in mind that they are games only, and are designed to bring out particular features of attack and defense. In the maneuvers in question, the object was primarily to afford practice to the personnel, secondarily to test the matériel in as far as the simulated conditions should permit. The character of the test was practically limited to discovering the target, determining its range and bearing, transmitting these to the gunners, and going through the motions of loading, pointing and firing. As such, the practice was eminently useful and satisfactory. The question of who won hardly enters at all. It was natural that some defects should have been brought to light, or at least made more prominent, and this feature in itself is a most valuable result of the maneuvers.

Some of the operations may now be taken up in order, and such comments made as may seem applicable. The first movement of the fleet was to secure a base from which attacks could easily be made on any part of the line of defense. Block Island proved convenient for this purpose. In actual war it would perhaps have proved useless and untenable. There is no shelter from the weather, and no possibility of defense against torpedo attack. As it was summer, and the army was not provided with any floating defense whatever, the position met the requirements of the occasion sufficiently well.

The first attack was a combined movement on Forts Michie and Terry. The *Brooklyn* and *Massachusetts* led in in the evening, the *Kearsarge*, *Alabama*, *Indiana*, and *Puritan* coming up on the opposite side in the early morning. Of course, the question to be settled is as to the fate of the first two. They laid a course to pass between Little Gull Island and Valiant Rock, and had got in to fairly close range before they were discovered. The searchlights did not seem to be of great assistance to the defense, as the beams were on the ships many times, fitfully; and when their final concentration showed that the ships were really made out, the range was pretty close, about 5000 yards. Had the ships been dull war color instead of glossy white, this distance would no doubt have been less. The course lay within 2700 yards of the batteries of Fort Michie, and the ships were some 15 minutes under the heaviest part of the fire. If they survived this punishment, their eventual position gave them command of the batteries in reverse. It is probable that there should be no reverse for batteries in such locations. In case of an attack in force, or at night, or in a fog, some of the ships would be reasonably certain to get through, though the others might be sunk, and once in rear, the batteries would be at their mercy.

The vertical base position-finder towers seemed exceedingly conspicuous. The light batteries of the ships were directed on these and on the searchlights, and must have disabled them early in the action. It is true that at such close ranges, direct sighting would have been used anyway, and the destruction of the towers would not have been of so great consequence. Still the towers are prominent marks at all ranges, and are good reference points for the batteries.

The ships coming up in the early morning were fairly close to Gardiner's Point before they were sighted. One of them ran on a contact mine and was put out of action. Two of the others were in the neighborhood of observation mines that were fired by judgment from shore, though it is not certain that both cross-range bearings were observed together. This mine field was a surprise to the ships. It was supposed that Plum Gut would be mined, but it is obvious that a line extending between Gardiner's Point and Great Gull Island will be equally effective, and though requiring more mines, it is not subject to strong tidal currents. After these ships had circled about for awhile in face of Fort Terry, while the *Brooklyn* and *Massachusetts* established a cross fire from the other side, all the ships finally withdrew as they had approached.

Fort Rodman at New Bedford is not really in the strategic district of the attack. Still, to give practice to all the personnel, a division under Admiral Coghlan was sent to engage these batteries. Light vessels preceded the heavy ones to develop possible mines and obstructions, and the final attack was made at anchor. The *Brooklyn* in coming out struck an uncharted pinnacle rock in the middle of the main channel. The rock has since been located and buoyed. The accident points to the grave necessity of careful resurveys of many of our coast channels and harbors.

The other principal operations were day and night attacks on Fort Wright and on the Newport defenses. The day attack on Fort Wright began by the battleships coming up before dawn under cover of Mount Prospect—the hill on the point of land just to the eastward of the batteries—and in the dead angle of direct gunfire. They were within mortar range, but it is doubtful if the range stations covered that part of the approach. After they rounded Mount Prospect, it was a close cannonade on both sides all along the front of the batteries, through the Race, and up to the northward, taking the works in reverse. The tactics of the approach in this case was distinctly good. It probably got the ships through the mortar zone without damage. After that it was a contest of strength, ending at the Race. If the ships were still afloat, the victory was theirs, for the batteries were helpless to the westward. The same comment applies as in the case of Forts Michie and Terry; there ought not to be any reverse.

The night attack on Fort Wright was simply a run-past. The *Brooklyn* and *Olympia* went ahead to make a diversion, while the battleships endeavored to get into close range undiscovered. The fire of the leading ships was directed entirely at the searchlights and observation towers, to pave the way for the real attack. The cruisers were probably sacrificed. The battleships got within 5000 yards before they were discovered, and went through with a favoring tide at 15 knots over the ground. They probably got through successfully, as they were not more than 10 minutes under fire.

The last day was devoted to the Newport defenses. There was a general bombardment in the afternoon and a forced entrance at night. The main channel had been countermined by the *Peoria* the previous night, as a cautionary measure, though, as it turned out, it had not been mined. The *Peoria* had been under fire for a short time while dragging the western channel, and had subsequently exploded her dummy countermines in the eastern channel without interference. Some question arose as to whether the two operations should be counted as a single phase, but the fact seems to be that her mission in the eastern channel was not recognized.

The bombardment was preceded by an attack on the signal and position-finder stations by the cruiser squadron. After this had proceeded for a reasonable time the *Kearsarge* and *Alabama* ran in near the Brenton Reef lightship, intending to gain a position in the dead angle of direct gunfire from all the forts.

The exact position was not occupied, for though sufficient water is shown on the charts, it is not a fair way and there was a risk of running on unknown rocks. In their actual position the ships were under fire of most of the guns and mortars, though in a real war the risk would have been assumed of occupying the actual dead space, notwithstanding possible rocks.

Another division, consisting of the *Massachusetts*, *Indiana* and *Puritan*, came up from the eastward and occupied a position off Ochre Point, at anchor, some 800 yards from the shore. The exact range of the batteries was obtained from the bearings at anchor, and the guns were fired over the cliffs at the elevation required for the range. To get the direction, observers were sent aloft to locate the forts and indicate their bearing, as for instance over a certain gable roof, or over a certain chimney. The effect of the fire could not be observed, but the range and direction were known absolutely and it was reasonable to suppose that the shots would fall with fair accuracy. The cliffs and houses did not interfere, as the trajectories, with full charges, passed three or four times higher than any intervening objects. No return was made to this fire, as the guns of the forts did not train in the direction of the ships, and there were no range stations for the mortars. Some had been planned, but they were not connected. This part of the bombardment was no doubt the decisive feature. Even should it be granted that the damage to the batteries was inconsiderable, owing to the impossibility of observing the effect of the fire, one of the reasons for the existence of the forts was the defense of Newport, and Newport was at the mercy of the ships.

The night attack was spectacular rather than useful. It would have been next to impossible in time of war. It could not have been attempted had the channel been thorougly mined and defended by controlled and automobile torpedoes and torpedo-boats. Under the existing conditions of din, smoke and search-light glare it was a very pretty and creditable bit of navigation, and was carried through with mishap of any sort. The ships went through in column at distance at a speed of 9 knots, steamed around Gould Island, and went out in the same order. This maneuver would have required some skill and care even in the day time.

A few of the conclusions that have been arrived at, or confirmed, as a result of the maneuvers may now be mentioned. In the first place, the conditions were artificial, and were devised with a special end in view, as has been stated. It would be impossible to suppose that in actual war the army would not have the co-operation of a floating defense. It might be said that the maneuvers tested the *shore* defenses. The *coast* defenses, in the full sense, did not enter at all. The outer line of coast defense is the fleet. Were it powerful enough, no shore defenses would be required. So, were all the shores fortified to the point of impregnability, a navy, considered in relation to defense alone, would not be necessary. Neither of these procedures is possible, or desirable. But a compact, mobile fleet will keep an enemy at a distance from our shores, or at least prove a predominating menace in case he slips through. In such a contingency, the second line of floating defense, and the shore defenses, find the reason for their existence. They are to hold the enemy until the battle fleet can dispose of him. No success in war comes from merely resisting attacks. There must be the power to strike. Forts might resist an enemy forever and never defeat him. But at the proper moment the fleet may exterminate him.

So the inner line of floating defense, and the fixed defenses work together. A mine field not patrolled may be swept, dragged and countermined in a fog. The heavy guns of the forts are the main reliance; but there should be light draft harbor defense vessels to lie on the shoals and harass the enemy; torpedo boats to deter him by night, and submarine boats by day; searchlights to illuminate him; and position finders to locate him and give his range to the gunners; submarine mine fields and batteries of automobile and controlled torpedoes to prevent his entrance; rapid-fire guns to cover the mine fields; and light vessels to patrol them: all these features in co-ordination constitute the perfect defense.

In our peaceful maneuvers an attempt was made to find the enemy by the use of searchlights. In most cases such use is apt to prove a positive disadvantage to the defense and a positive advantage to the enemy. Many nights' experience behind and in front of a searchlight has convinced the writer that under ordinary circumstances the mere flashing of the beams before the eyes of the observers gradually contracts their pupils until they cannot see as far, even on a bright moonlight night, as they can on an ordinary dark night without such questionable aids.

But if the lights are harmful in this way to the defense, in like degree they are an aid to the attack. They are a perfect lighthouse for purposes of navigation. Moreover they reveal the condition of mind of the defense. If the lights are sweeping slowly and regularly, it indicates a feeling of security. But let any suspicious objects appear; instantly the lights are dancing in every direction. They then settle down for a period of investigation. If the result is satisfactory, they resume the slow sweeping. So, when you are picked up; they pass over you fitfully once or twice, then they settle on you for an instant, and perhaps pass on satisfied. Then you hurry on to the best of your ability; but when they have got you finally, there is no mistaking it. If they had not used the lights they might have had you some time before, and you would never have known their intentions until a sheet of flame told you the game had begun. So in a concerted attack, the admiral makes a feint preparatory to the real attack. If he finds everything is going well in the direction of the feint, he may follow with the main attack in the same line. Or he may decide that a favorable diversion has been created and then push home his attack in another direction. None of this would be indicated were the searchlights not used.

There is one exception to this reasoning. In case the enemy must cross certain fixed zones or sectors, and these zones or sectors may be covered by fixed beams of light originating from points quite remote from the observers, then the logical use of the lights is apparent. So used, they are a great help to the defense, and the attack has nothing to do but make the best of the circumstance.

The method of getting touch of an enemy who has eluded the outer line of defense will most certainly be by means of the scouts of the inner line. These small vessels will no doubt be equipped with some practical system of wireless telegraphy, synchronized if possible and made proof against interference. After the receipt of whatever information may come from such a source, there will be nothing to do except keep a number of sharp-eyed observers, equipped with good night glasses, busily engaged scanning all the approaches, and the prospect of discovering the enemy's intentions will be as good as can be hoped for.

Searchlights is then a misnomer, as they should never be used in searching; but they are needed for illuminating the target in the interest of the gunners and range observers. Lights used for this purpose should be quite removed from the gunners and observers who depend on them. There are two reasons for this; first, the glare of the beams does not effect vision to such an extent; second, the reflected light seems better when it comes back at an angle with the original beam instead of in the same line, perhaps only through contrast. Some very comprehensive experiments made in Italy a dozen or more years ago determined that the maximum visual effect was obtained when the angle between the illuminating beam and the line of vision was 60° (from memory). This principle should be made use of in locating the illuminating lights. It is superfluous to add that all such lights should be effectually hooded on all sides except in the direction of the beam. The effect should be that of a bull's-eye dark lantern.

The term blinding lights has sometimes been used. The consensus of opinion afloat was that the blinding effect was of no consequence at the ranges that would be used in a bombardment. It is possible that in a torpedo-boat attack on ships the boats might be blinded at very close ranges, but at that point their work should be finished. The lights are used properly in this work only after the boats are discovered. The ships are best in darkness, leaving to the destroyers and vedettes the task of making known the approach of attacking boats. Some reports stated that the range observers ashore were occasionally blinded by the ships' lights, and recommended that the lights be directed on the range towers. This is probably desirable; at least, there is no doubt of it while the towers are under fire. Perhaps later the lights are best used on the batteries, or whatever may be the target for the moment.

To the observer afloat the various adjuncts at most of the forts come into a very marked prominence. Searchlight stands and vertical base-position towers seemed to be the worst offenders. There were also buildings and barracks that showed plainly, and while they had no offensive value, a well informed enemy would use them as marks by which to sight his guns at emplacements otherwise concealed. The modern idea in fortification is concealment and dispersion as opposed to the old protection and concentration. It would seem that the sky line of our forts should be a perfectly unbroken line with nothing to claim the eye of the opposing marksman. In the neighborhood of foreign works, peaceful objects of prominence are often razed with no other motive in view. Such a policy would eliminate vertical bases except on sites sufficiently elevated not to require an additional tower.

Some discussion has taken place in the fleet as to the advisability of steering sinuous courses in a mere run-past. Of course in a bombardment it is well to keep moving. But in a run-past, the main point is to save time. If a sinuous course is steered, it is evident that the changes must occur at least as frequently as the predictions of the range observers, otherwise the prediction holds for the new course. Now, assuming a certain speed of predictions, and the ship maintaining a general advance, how much can she change her position from that predicted in one interval of predictions by any possible change of helm or speed? If the change is less than the error of the prediction, or of the marksmanship at the given range, the attempt is entirely useless. It prolongs the time under fire and serves no useful purpose. The rest is a simple geometrical calculation, the data being given. With such data as the writer has been able to obtain, changes of course have nothing to recommend them.

During the period of the maneuvers the weather was persistently clear. In the absence of a floating defense, running the Race in a fog should be a perfectly practicable maneuver. It would most certainly have been attempted had the occasion arisen. The clear weather was of course to the advantage of the defense throughout, and the attack had nothing to do except make the most of it. The ships would have been much less conspicuous at all times had they been painted war color, and this should be done in future maneuvers. In fact, in the opinion of the writer, it would be much better to keep them war color all the time. They are more impressive, look more like business, create a better moral effect, are ready to take part in any exercises or maneuvers or search problems, permit experiments as to the best color of paint, and last and more important than all, are ready for work at any moment their services may be needed.

These joint maneuvers may well be continued. The gain to the coast artillery is probably greater than it is to the navy. It gives them their only possible opportunity of service under something like war conditions, whereas the navy is mobilized and at work at something most of the time. It brings about an understanding, too, between the services. The interchange of observers ashore and afloat, as provided under the rules, cannot but bring about a mutual feeling af good will and respect. The writer saw a good deal of the army during and before the maneuvers, and realized, as we all should, that in any future difficulties, we have got to stand shoulder to shoulder, and the better we know each other the better we can do it.

NORTH ATLANTIC STATION.

U. S. FLAGSHIP KEARSARGE (*1st rate*),

*Off Block Island, Rhode Island,* September 6, 1902.

BULLETIN:

The Army and Navy maneuvers having been completed the following is printed for the information of the Fleet:

The Fleet composed of:

Kearsarge,
Brooklyn,
Alabama,
Massachusetts,
Indiana,
Puritan,
Olympia,
Panther,
Montgomery,
Mayflower,
Gloucester,
Scorpion,
Supply,
Aileen,
Nina,
Leyden,
Peoria,

having rendezvoused Menemsha Bight by sundown Sunday, the 31st, ultimo, they were assigned as follows:

*First Squadron:*

1. Kearsarge,
2. Massachusetts,
3. Alabama,
4. Indiana.

*Second Squadron:*

1. Brooklyn,
2. Olympia,
3. Montgomery,
4. Mayflower.

*First Reserve Squadron:*

1. Panther,
2. Supply,
3. Nina,
4. Leyden.

*Second Reserve Squadron:*

1. Puritan,
2. Aileen,
3. Peoria.

*Scouts:*

Gloucester. Scorpion.

The *Nina* and *Leyden* to act as tenders and not a part of the force designated for the maneuvers.

After dark on the 31st of August the *Supply*, *Gloucester* and *Lebanon* (collier) were dispatched to Block Island to anchor off the entrance to Great Salt Pond and to await the arrival of the fleet. At 10:40 p.m., the same night, the Fleet got underway and headed to the westward. The *Olympia* was detached shortly after getting underway. The *Olympia* landed one company of Naval Reserves, in charge of Lieutenant Goodrich, M.V.M., at Gay Head, and occupied the signal station there; finding the station established by the Army a couple of days previously abandoned: then proceeded to Woods Hole and cut all the cables connecting Martha's Vineyard with the mainland; sending telegrams to General MacArthur that this had been done. The cables were actually grappled, hauled up on the bows of a launch and all tools at hand to cut cables, all this to the satisfaction of the Umpire.

The Fleet arrived off west side of Block Island at early daylight on the morning of September 1st. The *Brooklyn*, *Massachusetts*, *Indiana* and *Puritan* shelled Beacon Hill with secondary batteries. The *Alabama* landed two companies of bluejackets who advanced on Beacon Hill by two routes and captured it. There were a sergeant and four men in charge of the station, with no supports. The Army Observer on board the *Alabama* acceded to the capture with no protest. The marines from the *Kearsarge*, *Alabama*, *Massachusetts*, *Brooklyn*, and *Olympia* were landed and established a camp under command of Captain Magill, Fleet Marine Officer. The Fleet anchored and preparations were made for further operations; the small vessels and collier inside Great Salt Pond.

The *Scorpion* was dispatched at 10 a.m. September 2d to reconnoiter the channel around south end of Gardiner's Island. The *Scorpion* returned before dark, reporting that she had run on an obstruction and was placed out of action for repairs by the ruling of the Umpire. The obstruction was a barge 200 feet long, 10 feet deep, loaded with stone.

After dark on September 1st a Scouting Squadron, under the command of Commander Wilson, of the *Panther*, with the *Supply*, *Montgomery* and *Mayflower*, got underway and scouted the enemy's coast from Price's Neck, Newport, to Fisher's Island. This squadron located the search-lights along this part of the coast and drew the fire of all the forts at Newport while off Brenton Reef Lightship. They returned and anchored at Block Island about daylight.

The *Brooklyn* and *Massachusetts* left the Base about 10 p.m. September 1st to run through the Race, Gull Island passage, and take Fort Terry, on Plum Island, in reverse. The battleships *Kearsarge*, *Alabama*, *Indiana*, and monitor *Puritan* got underway at 1:40 a.m. September 2d and advanced to attack Fort Gardiner and Fort Terry from the south. Both fleets were in position by daylight, the fort on Gardiner's Island was put out of action by points, and a cross fire established on Plum Island. It is claimed from this action that Plum Island was captured and the Fort on Great Gull Island by position, the Fleet being in its rear where none of its guns would bear.

A force, composed of the *Brooklyn*, *Olympia*, *Puritan*, *Montgomery*, *Mayflower*, *Peoria*, *Aileen*, and *Gloucester*, under the command of Rear-Admiral Coghlan, was despatched the 2d instant, for an attack upon Fort Rodman, New Bedford. This attack was carried out the following day, the vessels returning to the Base that night, except the *Brooklyn* and *Peoria*. The *Olympia* had picked up the company of Massachusetts Naval Militia before this attack. The *Brooklyn*, in withdrawing from the action, struck an uncharted obstruction which dented her bottom slightly and delayed her return until the following day looking for the obstruction. The damage was not serious and she continued with the Fleet until the close of the maneuvers.

The morning of the 2d the *Leyden* surveyed a channel with 18 feet of water around the obstruction in the channel to the southward of Gardiner's Island, and joined the Fleet off Cerberus Shoal.

At daylight on the morning of the 3rd the *Kearsarge*, *Alabama*, *Massachusetts* and *Indiana* bombarded Fort Wright for about two hours, then withdrew and anchored at the Base. The ships steamed close along the south face of the fort, then doubled around Race Point taking the batteries in reverse; returning by the same course.

On the morning of the 4th about 4 o'clock, the *Kearsarge*, *Alabama* and *Massachusetts* got underway and stood for the Race, intending to run through as the weather was thick, but it cleared and they stood off to the northward and eastward toward Newport, then back to the Base where the *Indiana* joined them and they kept underway the rest of the day, the *Indiana* anchoring before dark. After dark the *Brooklyn* and *Olympia* leading, with the three battleships *Kearsarge*, *Alabama* and *Massachusetts*, about a mile behind, ran by the forts at the Race. The *Brooklyn* and *Olympia* directed their fire to put out the search-lights; also, to draw the beams of the search-lights to them and allow the battleships to get as close as possible before being discovered. The night was very clear and not the one that would be selected for such an undertaking, but the ruse was fairly successful and the battleships got within close range before they were discovered. The ships anchored about half-past one on the morning of the 5th off Horton's Point, Long Island, and got underway at five o'clock, proceeding to a place off Newport, outside of the range of the guns.

The afternoon of the 4th, an expedition, under the command of Commander Wilson, of the *Panther*, with the *Supply* and *Scorpion*, proceeded to Fort Pond Bay, Long Island, cleared the beach by shelling, landed the battalions, captured a force of 130 and some signal stations and held the place until ordered to withdraw the afternoon of the 5th. The *Scorpion* rejoined the Fleet.

The forenoon of the 5th the vessels rendezvoused off Newport for a bombardment. The plan of the attack was to anchor the *Massachusetts*, *Indiana* and *Puritan* off Ochre Point and shell Forts Adams and Wetherell over the land, enfilading Wetherell and taking Fort Adams in reverse. The *Montgomery*, *Mayflower* and *Scorpion* attacked a signal and observation station at Price's Neck. The Umpire allowed that this was put out of action, but the boats' crews sent ashore to capture the place were ruled out as captured or killed. The *Brooklyn* and *Olympia* attacked the station near Narragansett Pier, which the Umpire allowed was out of action after twenty minutes' shelling with the secondary batteries. The *Kearsarge* and *Alabama* bombarded Forts Adams and Wetherell by zigzagging in the dead angle, of direct gunfire, of Adams, Wetherell and Greble; the intention being to pass inside and to the eastward of Brenton Reef Lightship before turning out. It was not considered advisable to risk the ships for the purpose of maneuvers, inside the lightship, where uncharted rocks might be run on.

The night of the 4th, Lieutenant S. S. Robinson and Lieutenant C. F. Hughes, with the *Peoria* and a sailing launch cleared the channels at Newport by dragging and countermining. With the *Peoria* they dragged halfway across the western channel before being discovered and fired upon and they continued to drag completely across under the fire. They then planted countermines with buoys to mark the line of the mines in the eastern channel and exploded them, then anchored inside until the next morning. They were under the beams of the search-lights while countermining but were not fired upon. The next morning, under a flag of truce, they removed the mines and buoys, being dangerous to navigation, and found that all the fuses of the mines had operated.

The night of the 5th instant the *Brooklyn*, *Olympia*, *Kearsarge*, *Alabama*, *Massachusetts*, in this order, formed to run the batteries at Newport through the eastern channel. (The *Montgomery* sailed to New York, the other ships proceeded to the Base.) The ships started ahead about 9 o'clock in the evening and ran by the batteries, finding no difficulty in navigating in spite of the glare of seven or eight search-lights directed upon them at once. (The guns were not fired, except by the rear vessels, as the smoke might have caused a serious accident.) The vessels turned around Gould Island and went to sea, returning to the Base and anchored.

The morning of the 6th the whole Fleet, with the exception of the *Montgomery*, was anchored at the Base, Block Island, R. I. The *Kearsarge*, *Alabama* and *Massachusetts* passed in review before the forts at the eastern end of Long Island Sound, returning to Block Island and the maneuvers were completed.

FRANCIS J. HIGGINSON, *Rear-Admiral,*
*Commander-in-Chief U. S. Naval Force, North Atlantic Station.*

# AMMUNITION SERVICE FOR MORTARS.

By First Lieutenant CHARLES L. LANHAM, Artillery Corps.

The following is a brief description of the method of supplying projectiles to mortar pit "C", Battery Anderson at Fort Monroe, Virginia, manned by the 58th Company Coast Artillery.

The accompanying drawing shows the location of shell room, trolleys, etc., and the positions to be occupied by trucks.

It should be mentioned that the system depends upon a pit being supplied with four differential pulleys and four trucks for each of the three characters of projectiles now contemplated; viz., 800 and 1000 pound D.P. and 1000 pound torpedo shell. A sufficient number of shot tongs should be provided to supply four projectiles of each character in addition to the four already hooked to the pulleys, (sixteen in all).

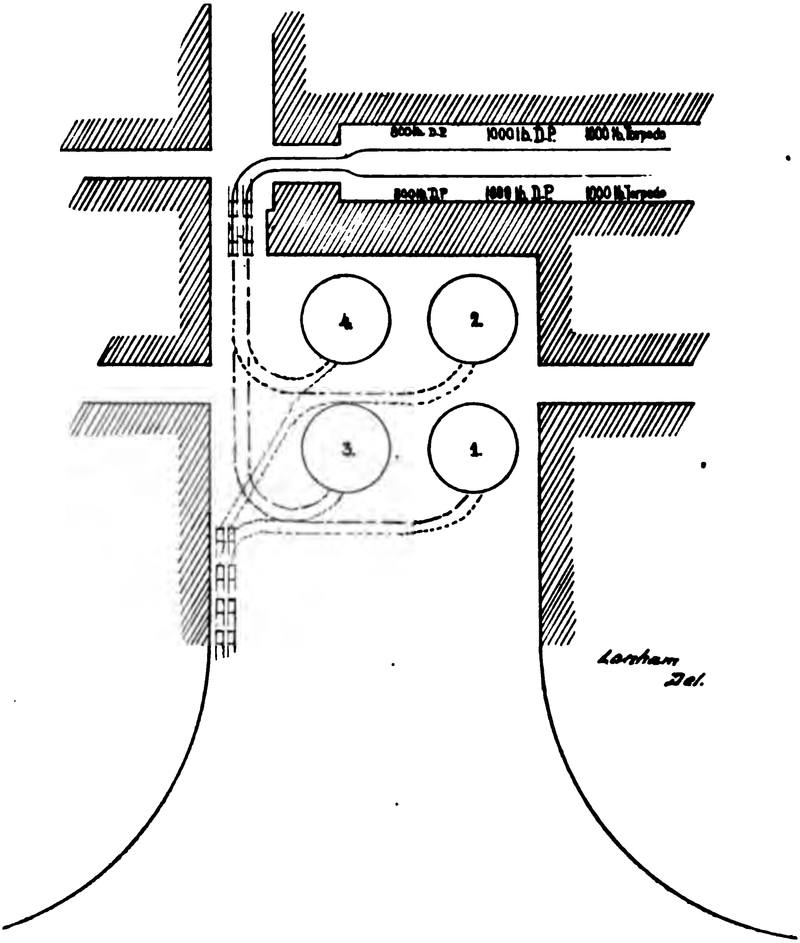
The system is explained for the use of the three classes of projectiles mentioned above, it being understood that in future they are to be used exclusively, but it can be readily extended to include others by having additional trucks, loaded and occupying an advanced position in the pit as shown in the drawing.

In the shell room the projectiles are arranged in similar lots on each side of the room. They should be piled in tiers with the points towards the wall and tiers separated by wooden skids.

The four ammunition details, each consisting of a non-commissioned officer and five privates, are assigned duties as follows: The senior non-commissioned officer is in general charge of the service of projectiles and is ordinarily charged with the duty of conveying information from the pit to the shell room of the character of projectile being used at each loading, and is in charge at the entrance to the shell room, *i.e.*, where the projectiles are placed on the trucks. One non-commissioned officer on each side of the shell room superintends the fuzing and raising of projectiles. One non-commissioned officer is in charge of magazine. Two privates (Nos. 1 and 2 of each detail) with each pulley, hoist and carry a projectile to the entrance, lower it on its truck and return with the pulley. Two privates (Nos. 3 and 4 of each detail) fuze and grapple a shell with the shot tongs. One private (No. 5 of each detail) is in the magazine to pass out a cartridge to number 7 who comes from his piece.

Before the beginning of an engagement two projectiles of each character on each side of the shell room, are fuzed and grappled, and four trucks at the entrance are loaded with four more fuzed projectiles of the character first to be used, (presumably 800 pound D.P.).

The trucks are placed according to the tactical numbers of the pieces and each truck is pushed to its piece over the route shown, thereby occasioning no crossing in transit or confusion when being returned.



The first four additional trucks are loaded with fuzed projectiles of the character next to be used (presumably 1000 pound D.P.), and are placed in an advanced position and out of the way as shown. The second four additional trucks are loaded with fuzed projectiles of the class next to be used (presumably 1000 pound torpedo).

Assume the command is given to load with 800 pound D.P. shell; the charge details immediately serve the pieces with that class and return the empty trucks to the places formerly occupied by them under the trolleys. As soon as this command indicating character is given, the ammunition details fuze and grapple four more (two on each side of the room) of the same character, and, when the trucks have returned they are loaded with the four of that character (800 pound D.P.) which were fuzed at the beginning and are in reserve. If the next command be with "800 pound D.P." the same routine is observed.

When during action the kind of projectile is to be changed, (presumably to 1000 pound D.P.) the pieces are served with that designated and the empty trucks returned to the shell room entrance to receive four more of the same character from the reserve, the ammunition details in the meantime fuzing four more to hold in reserve.

When the character is changed it necessitates the removal of the trucks at the entrance loaded with 800 pound D.P. to the position just vacated by those loaded with the character then being used (1000 pound D.P.). This is done by the charge details after serving the pieces.

In a similar manner the change to 1000 pound torpedo can be made or back again to either of the other classes without losing a single round.

Thus, always having on hand at the beginning four trucks loaded with each character of projectile to be used; having a fuzed reserve in the shell room of four of each character; and the ammunition details immediately preparing four more of the character being used at any loading; the supply is both constant and rapid and admits of instant change, as four projectiles can be readily raised and placed on trucks in a two minute firing interval, which, it is believed, is the minimum yet attained.

# FRENCH RAPID-FIRE FIELD ARTILLERY.

## ITS MATERIAL, FIRING METHODS, AND MANNER OF EMPLOYMENT.

COMPILED BY CAPTAIN ANDREW HERO, JR., ARTILLERY CORPS.

## II.

### 5. LAYING APPARATUS AND INSTRUMENTS USED IN PREPARATION FOR AND EXECUTION OF FIRE.

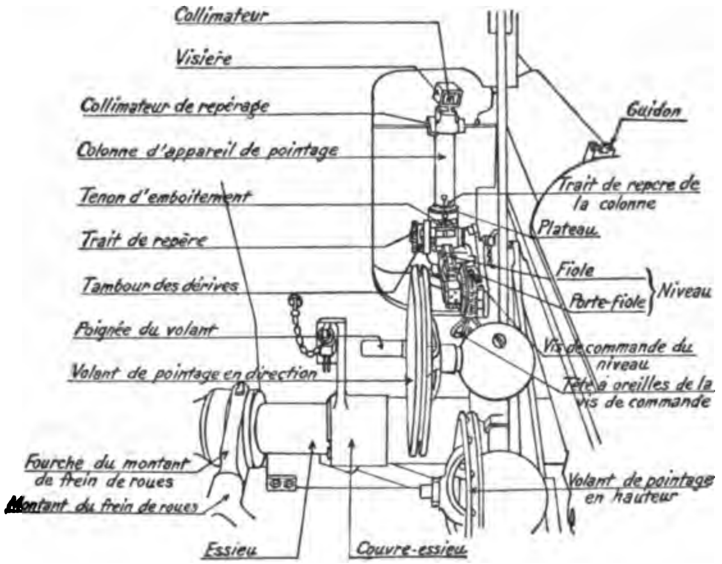
The characteristics of the French material thus far described make evident the resulting advantages as regards great rapidity of loading and firing and, to some extent, the possible rapidity of aiming due to the practically stationary carriage. But the carriage is not so rigid that there does not occur a slight loss of aim from shot to shot, which necessitates bringing the gun back to the target every time it is fired. The French have, accordingly, successfully improved the means of laying, and thereby secured the necessary rapid aiming by special arrangements which are by no means less important than other features of this new material. It is the combination of controlled recoil and improved laying mechanism which has produced a system of field artillery greatly superior in efficiency to any former system.

The instruments that will now be described are: the laying apparatus and level which are carried by the gun; the battery telescope, model 1898; the débouchoir or fuze cutter which is carried by the caisson; and the hand scale for direction.

The units of angular measure adopted for deflection or lateral sight allowance are called millièmes, each being practically $\frac{1}{1000}$ of the distance of the object aimed at; that is to say, if the plane of fire is turned through this unit angle about its intersection with the vertical plane containing the line of sight, all points in the plane of fire will be displaced by an amount equal to a millième of their distance from this line of intersection, that is from the piece. There are in round numbers 1,600 millièmes in a quadrant.

The laying apparatus serves to direct the gun upon the target. The support of this apparatus or sighting mechanism, connected to the left arm of the cradle, consists of a socket, locking tenon, micrometer screw with head (tambour des dérives) and its gear. In the socket fits the foot of the column which bears the laying apparatus. This column assumes a secure and definite position with reference to the support when the locking tenon is slipped into the groove of the column.

Fig. 7. Laying apparatus, Collimator, etc.


Collimateur
Visière
Collimateur de repérage
Colonne d'appareil de pointage
Tenon d'emboitement
Trait de repère
Tambour des dérives
Poignée du volant
Volant de pointage en direction
Fourche du montant de frein de roues
Montant du frein de roues
Essieu
Couvre-essieu
Guidon
Trait de repère de la colonne
Plateau
Fiole
Porte-fiole
Niveau
Vis de commande du niveau
Tête à oreilles de la vis de commande
Volant de pointage en hauteur

ENGLISH NOMENCLATURE.

Collimator.
Collimator case.
Special Collimator.
Pedestal of Laying Apparatus.
Locking Tenon.
Index Mark.
Micrometer-head
Handle of Handwheel.
Traversing Handwheel.
Fork of Stay for Tyre Brake.
Stay of Tyre Brake.

Fore Sight.
Index mark on Pedestal.
Base-ring (graduated).
Glass } Level.
Glass-holder } Level.
Adjusting Screw of Level.
Head (thumbpiece) of Adjusting Screw.
Elevating Handwheel.

Axle.
Axle Sleeve.

The laying apparatus consists of a collimator mounted on a cylindrical pedestal. The collimator is an optical arrangement, equivalent to a sight of infinite length, at right angles to the pedestal or upright. When the collimator is looked at from the layer's seat two lines of light are seen on a dark background, one vertical and one horizontal corresponding exactly to the cross-lines of a transit. These lines are termed "lignes de foi."

The pedestal can be rotated within its base-ring (plateau) and around its own axis by disengaging the 32 teeth of the base-ring from the corresponding 32 teeth borne by the pedestal and held in gear by a spring at the bottom of the pedestal. By placing the palm of the hand on top of the collimator case and pressing down firmly the teeth are ungeared and the pedestal can be rotated freely, and thus its index mark can be set at any desired graduation of the base ring. The apparatus is, therefore, especially adapted for indirect lay which the French regulations lay much stress on.

At the base of the pedestal is the graduated plate or base ring which shows the angle through which the pedestal is turned. This ring is divided into four quadrants each one of which is divided into eight parts, and the divisions are marked 0, 2, 4, 6, ..........12, 14 in each quadrant. Each space then of the graduation equals $\frac{1}{8} \times 90^\circ$ or $11^\circ 15'$, and corresponds to an angular displacement equal to 200 millièmes or $\frac{200}{1000}$ of the range. The zero mark indicates the separation of two consecutive quadrants. The divisions, 0, 2, 4, 6, etc., can equally well be read 16, 18, 20, etc., in certain cases in correcting for the lateral sight allowance.

When the micrometer-head (fig. 7) is turned, it causes the whole pointing apparatus to turn on its axis by a continuous movement, and this movement has exactly the amplitude required to give the collimator all the positions intermediate between any two obtained by turning the pedestal directly by hand in its base ring. The micrometer-head is graduated from 0 to 200; each of its divisions, therefore, corresponds to one millième or $\frac{1}{1000}$ of the range; that is, turning the micrometer-head one division gives an angular displacement to the collimator of $\frac{1}{1000}$ of the distance of the object aimed at. If a reading of more than 200 millièmes is to be given, as 250 for example, the pedestal must first be set by hand at plateau 2 and then the micrometer-head turned to 50.

It is readily seen, then, that the divisions on the plateau (base-ring) are the even hundreds (2, 4, 6, ........) of which the divisions on the tambour (micrometer-head) are the units; any lateral allowance, as 205 would be called out *Plateau 2.—Tambour 5;* 570 would be announced, *Plateau 4.—Tambour 170.* This is the method actually used in drill and firing.

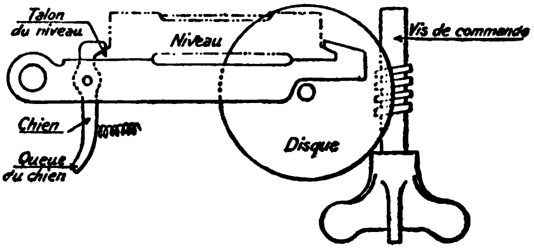
When the index mark of the pedestal is set at the 0 before the micrometer screw and the micrometer-head is at 100, the vertical plane of sight containing the vertical line of the collimator is, by construction, parallel to the plane of fire. This is the position in which the pedestal and micrometer-head are set when the laying apparatus is first put in its support; after which, the lateral sight allowance being determined, the pedestal can be rotated and set as above explained.

Drift, the effect of wind, and difference of level of the wheels are compensated for, if necessary, by thus turning the collimator pedestal on its vertical axis and by the use of the micrometer-head. When the wheels, the shields, the chase of the gun, or the relief of the ground prevent the gunner from giving the initial direction to the piece by means of the collimator, use is made of extension pieces of the laying apparatus. With the pedestal alone, the collimator (and, therefore, the line of sight) is 47 inches from the ground; with one extension piece on the pedestal, it is 59 inches high and enables one to sweep the whole horizon. If the relief of the terrain be still more accented, however, two extension pieces may be used, fitting into each other, and raising the collimator about 71 inches above the ground. The gunner then stands on the seat. These extension pieces are intended for only the first laying of the gun; after that the ordinary collimator and pedestal alone should be used in conjunction with some other aiming point. The extension pieces must never be left in position during firing.

When the pedestal is at zero, tambour at 100, and the range disk on the right of the gun is at zero, the optical axis of the collimator is parallel to the axis gun. The range having been judged or measured, the graduated range disk on the right side of the piece is set to the corresponding reading, and after that, laying in elevation consists solely in giving the angle of site* to the cradle. For the first shot this angle can be given either by means of the level or by means of the collimator. For all succeeding shots, laying in elevation is always done by means of the level.

LEVEL.—On the support of the laying apparatus and immediately in rear of the pedestal is an adjustable spirit level consisting of the usual glass tube in a metal cover. One end is pivoted on the support and the other end can be raised or lowered by a tangent screw (vis de commande, figs. 7 and 8) which at the same

Fig. 8. Level on support of Laying apparatus.



ENGLISH NOMENCLATURE.

Claw of level. Adjusting Screw.

Level.

Catch. Graduated disk.

Toe of Catch.

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*The angle of site is the angle made with the horizontal by the line joining the gun and the target.

time turns a graduated disk. An index serves to read the divisions on the latter, which measure the angular displacement of the level. The angles are graduated every five millièmes of the range and numbered every 10 millièmes, + and — each side of the zero. When the index is at zero, the level is parallel to the line of sight of the collimator. The signs + and — indicate respectively the direction in which the adjusting screw must be turned in order to raise or lower the end of the level according as the target is above or below the gun.

A gun having been laid in elevation with the collimator (by turning the elevating handwheel until the horizontal line is brought along the foot of the target) and the bubble of the level having then been brought to its central position by means of the adjusting screw, if the graduated disk reads + 20, for example, it signifies that the target is $\frac{20}{1000}$ of the range higher than the gun. If this range is known to be 3,000 yards, this difference of altitude would be, accordingly, $\frac{20}{1000} \times 3{,}000 = 60$ yards. This procedure indicates the method of measuring the angle of site by means of the collimator and level.

Conversely, if the difference of height between the gun and target at a range of 3,000 yards, for example, is measured by the map or battery telescope and thus known to be —15 yards, the disk would be set with the index at the division —5, a millième of the range being $\frac{3000}{1000}$ or 3, and $\frac{15}{3} = 5$. The bubble is then brought to the centre of its run by using the elevating handwheel on the left side of the piece. The angle of site is always called out in multiples of five millièmes.

When the angle of site or that of the point of aim is too great to enable the vertical collimator line to be directed on the target, the special collimator on the side of the pedestal of the laying apparatus is used. This collimator is movable about a horizontal axis and can be given any desired inclination in the vertical plane.

A separate hand level, model 1888, is also provided for use if required, and a plane for it is provided on the top-carriage. This level is quite similar to our gunner's quadrant, and its principal use is for the verification of the lines of sight* and for testing the level on the support of the laying apparatus.

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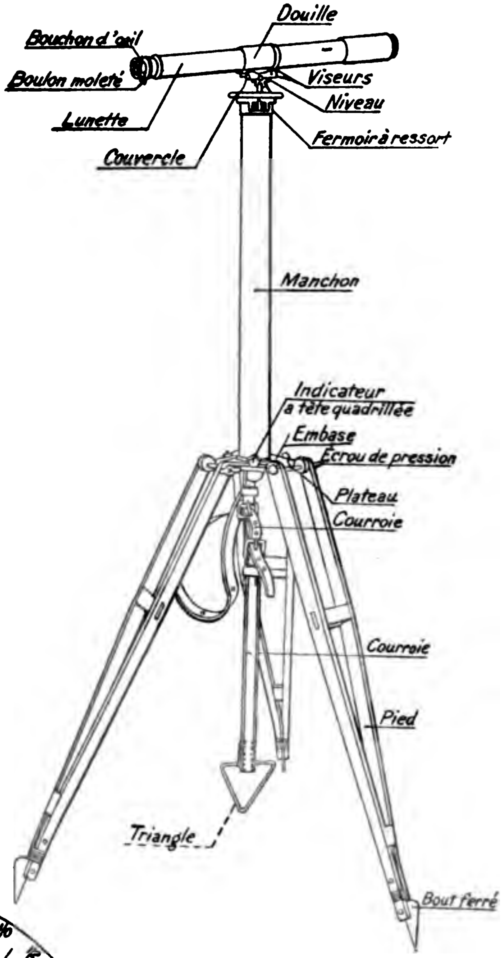
* The verification of the lines of sight consists in verifying:

1. That the optical axis of the collimator is parallel to the fixed line of sight determined by the peep-sight on the breech and the foresight on the jacket when the graduated range disk and plateau are at zero and the tambour at the division 100.

2. That the level of the laying apparatus gives with sufficient exactness the angle that the axis of the gun makes with the horizontal when the range disk is at zero.

This verification is made once a month as a rule, and oftener if necessary.

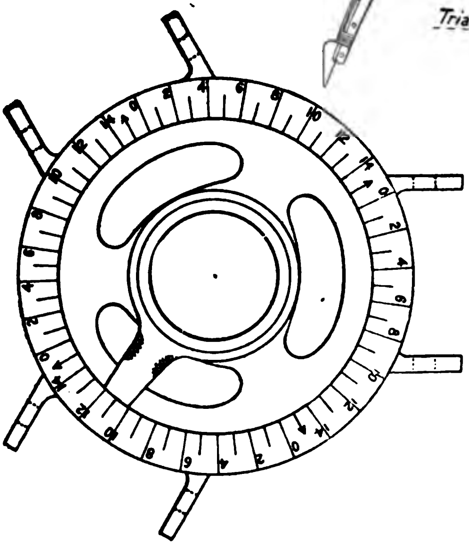
Fig. 9. Battery Telescope.



ENGLISH NOMENCLATURE.

Sleeve.
Eyepiece. Sighting Notch.
Milled Screw. Level.
Telescope. Spring Catch.
Cap.
Tube.

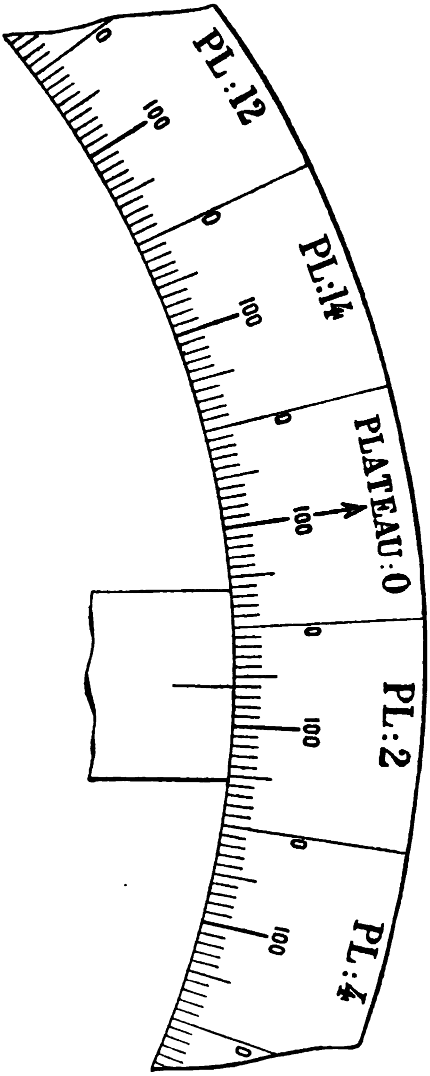
Pointer.
Base Plate.
Clamping Screw.
Graduated Plate.
Strap.
Strap.
Leg.
Triangle. Spike.



Graduated Plate on Telescope Stand.
(See fig. 10).

The French who have had more time and opportunity to think out the best use of rapid-fire field artillery lay much stress in the regulations on the batteries keeping themselves concealed. The regulations scarcely ever speak of laying on the *target*, but of laying on a "point de pointage," and by means of the arrangements above described the advantages of indirect laying are readily secured. But further than this, used in conjunction with another instrument, the battery telescope, they enable the battery to open fire on any object from a concealed position, provided that the telescope can be placed in a spot from which both the target and battery can be seen; and it is unnecessary for any one except the man with the telescope to give the enemy a chance of seeing him.

Fig. 10. Graduation of Plateau of Battery Telescope.

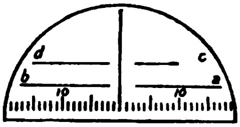


THE BATTERY TELESCOPE.—The general features of this instrument are illustrated in fig. 9. It serves to observe the firing and is also designed to: 1. Measure angular deflections in millièmes and to translate this measure at once into numbers corresponding to the graduation of the plateau and tambour of the laying apparatus; 2. measure the height of the points of burst and principally to correct the type height of burst; 3. measure the angle of site.

The graduations of the plateau or graduated plate which serve to measure horizontal angles (fig. 10) correspond to those on the plateau of the laying apparatus; but the interval between any two divisions corresponding to two consecutive divisions of the plateau of the laying apparatus is divided into 20 parts, each of which equals 10 millièmes and, therefore, equals 10 divisions of the tambour. The middle division of each interval is drawn in red and marked 1'00; it corresponds to the division 100 on the tambour. The graduations are read in the direction of the hands of a watch. In fig. 10 the reading would be; *Plateau 2, tambour 60.* Each of the small divisions being 10 millièmes, 5 millièmes can easily be estimated and read off.

For reading small angles the micrometer divisions in the field are used. (fig. 11). Each of these divisions corresponds to one millième. They enable the angular distance between the point of burst and the target to be measured; also the height of burst. The type height of burst can be measured by means of the horizontal lines in the upper half of the field. When the telescope is pointed, the point sighted on is brought to the lower end of the long vertical line in the centre of the micrometer. The horizontal line a b then marks the typical height of burst, and the line c d double the typical height. To estimate heights greater than this, the telescope is turned in its sleeve until the graduations of the micrometer become horizontal and the lines a b and c d vertical. Vertical angles can then be read off the scale up to forty thousandths of the range.

Fig. 11. Graduation in Field of Battery Telescope.



To measure the angle of site the telescope is turned in its sleeve as above and then brought horizontal by means of the graduated level attached to it. The angle is then read off in millièmes from the division of the micrometer opposite which the target is seen.

DÉBOUCHOIR.—This is a piece of apparatus for cutting the fuze so that at any range the burst of the shell will take place at the desired height. Fig. 12 shows a drawing of the débouchoir double which was used with the old equipments; that used with the 75 mm. equipment seems to be practically the same. It is carried by the caisson* and is hinged up for travelling as shown in plate iv. When in use it is let down to the rear resting on the ground, and is worked by the cannoneer who kneels in front of it.

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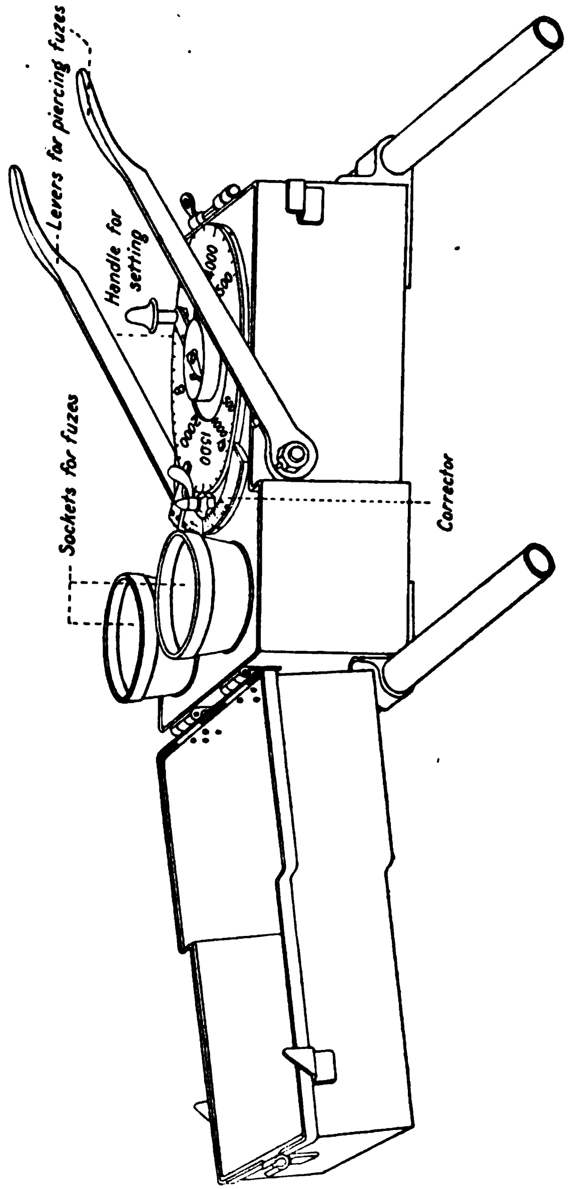
* See *Journal U.S. Artillery*, July—August, 1902.

Its interior mechanism is covered by a box of steel with steel top and hasp. The shells are placed, fuzes down, in the bronze

Fig. 12. Débouchoir.



sockets and are turned round till a stud or projection on the fuze falls into a slot in the socket of the débouchoir, thus causing the fuze to be placed in the socket always in the same relative position. The fuze is then in the right position for being punched. But first the débouchoir must be set.

For this purpose, the corrector and the graduated plate, shown in fig. 12 and known as the cadran, are provided. The corrector is an arm which bears an index and a friction clamp and moves along an arc graduated in millièmes from 0 to 40. The cadran or graduated range plate is graduated in distances up to 5,500 metres exactly like the graduated range disk on the right side of the piece. This plate is set at the desired range by the handle shown in the figure.

*To Cut a Fuze.*—The shells are properly placed in the sockets. A command is given: *Corrector 16.* The cannoneer unclamps the corrector, moves it along the arc until its index is opposite the division 16, clamps it and announces in a loud voice: *Corrector 16.* The command for range is then given: *2,500.* The setting handle of the cadran is seized, the cannoneer pressing down upon it to disengage it, and the cadran is turned until the division 2,500 is brought opposite the index of the corrector. The handle is released and the reading is again announced, *2,500.* Either the right or left lever for punching the fuzes is then firmly and quickly pressed down as far as it will go, then raised again to the vertical position and released, after which the shell is removed.

Each division of the corrector corresponds to one millième or $\frac{1}{1000}$ of the range, and it is so constructed that when its index points to 20 on its own sector and at the same time points to some known range indicated on the cadran, then the fuze will be cut to burst at the typical height of burst for that range. This height adopted is $\frac{3}{1000}$ of the range. To raise the point of burst, the corrector is increased by as many divisions as there are millièmes desired to be added to the height of burst; to lower this point, the corrector is moved in the opposite direction. If the observed height of burst is not good, or it is desired to use any other height than the typical one, a change in the height of burst can be quickly made by moving the corrector to some other division between 0 and 40 and then bringing the division on the cadran, corresponding to to the range used, opposite to the new place of the index of the corrector.

Thus very small changes in the height of burst can be made and all changes correspond with and are read in the same units (millièmes) as changes made in the elevation of the gun.

Hand Scale For Direction.—This is a wooden scale with graduations on both sides, the intervals of which correspond to angles of 10 millièmes when the scale is held at a distance of 50 cm. from the eye. A silk cord with a button which is passed through the upper button-hole of the coat, and the length of which can be suitably regulated by the operator, enables this distance to be accurately maintained. The scale is intended to measure angular deflections. It is so marked that the reading can be taken directly in terms corresponding exactly to the divisions on the plateau and tambour of the laying apparatus. The instrument is used by the battery officers to lay the gun approximately, using some auxiliary aiming point, to judge the angular distances between the point of burst and the target, or to measure the front of an objective.

Fig. 13. Hand Scale for Direction. Target to the Left.

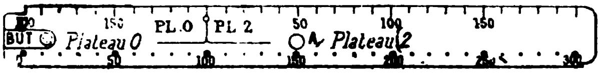
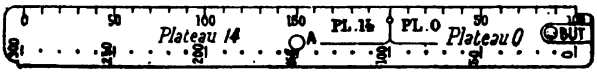


Fig. 14. Target to the Right.



The Graduations of Plateau 2 and Plateau 14 are Marked in Red.

The scale being held correctly for these different purposes, as shown in the figures, the readings are taken directly from the scale: *Plateau 2, tambour 60*, (fig. 15). Figures 15, 16, 17 fully illustrate its use.

Fig. 15. Target to the Left.

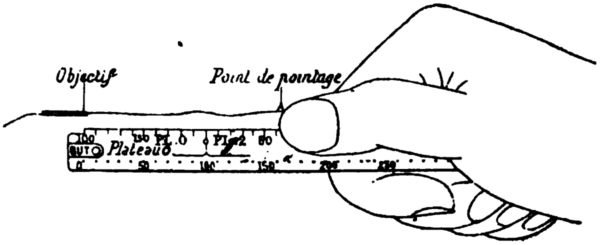


Fig. 16. Target to the Right.

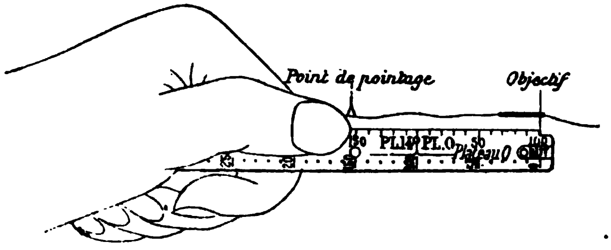
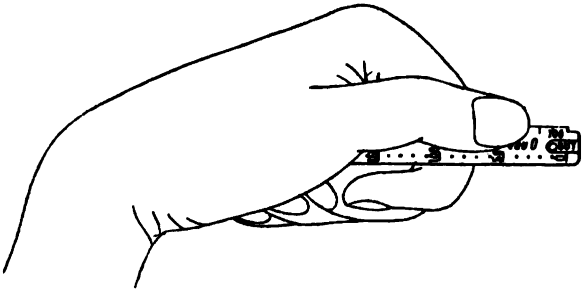


Fig. 17. Measurement of a Front.



INITIAL ELEMENTS OF FIRING.

The determination of the initial elements of firing precedes the opening of fire, and the precision with which this determination is made exercises a marked influence on the regulation and rapidity of fire.

The initial elements of firing are the lateral sight allowance, which determines the direction of each piece; the angle of site, which determines the inclination of the cradle; the range, which determines the angle of fire with respect to the plane of site; and the corrector, which fixes the height of bursting.

(a) Lateral sight allowance.

*Distribution of Fire.*—The direction of each piece is determined in such a way that the firing as far as possible may be distributed from the commencement of the firing over the whole front of the objective which, for this purpose, is divided into four equal sections.* The fire of each piece is first directed a little to the left (about 5 millièmes) of the right extremity of its particular objective. A battery can thus cover at average battle ranges: 1, with time-fuze fire, without sweeping (fauchage), a front of troops of about 100 metres; 2, with time-fuze fire with sweeping, a front of troops of 200 metres; 3, with percussion fire, a width of obstacle of about 25 metres. At average battle ranges (about 2,500 metres) one piece can cover with time-fuze fire and height of burst equal to the type height, a front of 20 metres (10 millièmes) without sweeping, or 25 metres if two successive shots are fired with the same elevation ; a front of 50 metres (20 millièmes) with sweeping, and with percussion fire, a front of 6 to 7 metres.

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* A battery consists of four guns.

*Methods of Pointing.*—A battery can employ individual pointing or collective pointing. Individual pointing applies in cases where the front of the objective is clearly defined at its two extremities for all the layers, and in cases where the objective is in movement. Collective pointing applies generally in all other cases.

*Individual Pointing.*—This comprises, first, the designation of the objective and the limits of its front ; second, the designation for each piece of an initial lateral sight allowance. This initial allowance is intended to take into account the drift corresponding to the range, and, if there is any reason for it, the effect of the wind, of the inclination of the axle, and of the lateral movement of the target. The values which it is necessary to give to the tambour or micrometer-head for the effect of drift are marked on the tambour. The captain makes the correction for the lateral effect of wind, allowing 5 millièmes for a wind of mean strength at average ranges, and 10 millièmes for a very strong wind or at greater ranges. The chiefs of section prescribe the correction for the inclination of the axle, allowing 5 millièmes for 15 centimetres difference of level of the wheels. It is rarely necessary to take into account these three corrections. The captain corrects for the lateral movement of the target, prescribing a correction equal to 5 millièmes for passage across the field at a walk.

The principal correction is that resulting from the angular distance between the point of aim and the particular target of any piece. This is equal to the value of this angular deflection expressed in millièmes and is measured at the position of the piece, It is positive or negative, of course, according as the particular objective of the piece is seen to the left or right of the point of aim.

*Collective Pointing.*—In collective pointing it would take too long, and moreover it would often be difficult or even impossible, to proceed in the manner just described for each of the four pieces of the battery. Accordingly, the following operations are performed ; first, the convergence of the planes of fire of the four pieces, all on the same point of the objective, is determined ;

second, the fire of the four pieces is then distributed over the whole front of the objective. That is to say, all the guns are pointed upon the same point with different lateral allowances, such that the front of the objective is uniformly covered throughout its whole extent.

The plane of fire of the right piece should pass about 5 millièmes to the left of the right extremity of the objective. The other pieces receive a correction for lateral sight allowance called echeloning, representing the number of divisions of lateral allowance that each piece ought to add to the lateral allowance of its neighbor on the right so as to be pointed on the portion of the target that it should cover. Collective pointing comprises, first, the designation of the point of aiming (point de pointage); second, in the general case, the designation of the objective and its front; third, the designation for each piece of the initial lateral allowance. The point aimed at is designated either directly or by the aid of an auxiliary mark. It ought, above all, to be very visible and not to be confused with similar neighboring objects. It ought, moreover, to be situated as far as practicable at a range from the battery greater than 1500 metres. The designation of the objective is made by the announcement of the angular distance of its right flank from an auxiliary mark which will be in general the point of aiming. This angular distance is determined by the aid of the battery telescope, by the field glass, by the hand scale for direction, or, finally, by the fingers of the hand. To determine the initial lateral allowance for each piece the captain, standing near the right piece or the position that it is to occupy, measures in millièmes the angular distance between the point aimed at and a point of the objective a little to the left of the right extremity of the latter. He measures likewise the front of the objective in millièmes. By the aid of the first element he determines the lateral allowance for the first piece; he indicates this allowance to the chiefs of section, and prescribes for the other three pieces an echeloning equal to a quarter of the front (échelonnement de répartition). This echeloning is always made by an increase starting from the lateral sight allowance of the right piece.

For example: The objective is to the right of the point of aim; the angular distance between the point of aim and the point on which the fire of the first piece is to be directed is 70 millièmes; the breadth of front is 40 millièmes; the captain gives the following directions:—

Point of aim: such a tree, or other prominent object;

First piece ; Plateau o tambour 30 ;
Echelonnez de 10 ; (other pieces, at intervals of 10);
The second piece would then take, Plateau o tambour 40 ;
The third piece Plateau o tambour 50 ;
The fourth piece Plateau o tambour 60.

When the initial lateral allowance has been given, each piece is laid in direction on the point of aim. If the point to be aimed at is situated at a distance from the battery less than 1500 metres, the captain modifies the echeloning allowance by the aid of a correction called a convergence correction, equal to the difference of parallaxes of the point aimed at and the point of regulation of the first piece. The regulations describe in detail how convergence, parallelism and divergence of fire is obtained.

### (b) Angle of Site.

When the battery comes into action, one of the first things to be ascertained is the angle of site. This may be measured by the battery telescope ; by the collimator and level, by bringing the prolongation of the horizontal ligne de foi of the collimator on the foot of the target by elevating or depressing the gun, after which the bubble of the level on the support of the laying apparatus is brought to its central position by the adjusting screw and the angle of site read on the graduated disk ; or by means of the map.

The angle of site must be determined with great accuracy, and in all cases in firing against a fixed target it should be obtained by means of the battery telescope and should be given to the gun by means of the level. Its determination by means of the collimator should be avoided ; this procedure is necessary in the case of a moving target, and in some few cases in firing against fixed targets it gives to each piece its proper angle. But, on the other hand, when the collimator is used, it is difficult to get each piece laid on exactly the same point of the target ; if this is not accomplished the heights of burst appear irregular and it becomes difficult to get the right length of fuze and thus to regulate the fire.

When it has once been obtained, the level is set to this angle and is not to be altered by the layer without orders.

### (c) Range.

The range can be measured by means of the map, by sound, or by a range-finder. These results may be vitiated by inexact evaluation of the angle of site. The range can also be deduced from the information furnished by reconnaissances, by previous firing, or by that of neighboring batteries which have adopted the same angle of site or which have pointed directly. Through lack of these means the distance is estimated by simple observation.

### (d) Corrector.

The angle formed by lines drawn from the gun to the foot of the target and to the typical height of burst adopted is called the hauteur-type. A projectile is said to burst at the hauteur-type when its point of burst as seen from the battery is 3 millièmes or $\frac{3}{1000}$ of the range. This height is that which gives the maximum efficiency of time-fuze fire and is the same for all ranges.

The hauteur-type is obtained normally with the corrector set at 20; but various accidental causes (atmospheric variations, inexact determination of the angle of site, etc.) may influence it. When the fire has to be regulated by observation of time-fuze projectiles, the initial corrector which will give bursts at the type height should be diminished by 2 millièmes; in other words, the typical height of burst is reduced from $\frac{3}{1000}$ of the range to $\frac{1}{1000}$. This is done by making the corrector read 18 instead of 20. In order that this proceeding may not give rise to error it is indispensable that every gun in the battery be pointed with the same angle of site; otherwise there may result as many as 4 different heights of burst, and the captain cannot regulate his fuze.

### PREPARATION FOR FIRING.

*Detachment.*—The service of the 75 mm. gun is generally executed by six cannoneers. Each gun has also a chief of piece who is in general charge. Of the six cannoneers, when in action, 2 kneel in rear of the up-ended caisson body, withdraw the cartridges from the caisson and place them fuzes down in the sockets of the débouchoir in the proper positions for punching the fuzes, keeping the débouchoir constantly supplied with cartridges. The cartridges should be taken alternately from the top and bottom row, working from the outside of each row toward the interior.

The fuze setter also kneels in rear of the caisson, takes charge of the débouchoir, sets it, works the levers for punching the fuzes, and passes the cartridges to the loader, who stands in rear of the layer and loads the gun. The firer sits on the right of the gun, facing the breech; he attends to the breech mechanism, fires, and sets the graduated range disk to the range ordered. The layer sits on the left of the gun, seats the laying apparatus, and sets it for direction by means of the graduated base ring (plateau) and micrometer-head (tambour); he also attends to the level; he lays the gun for direction and for angle of site. The men carry magazine carbines slung over their shoulders; these are placed against the wheel of the caisson body when in action. (Plate ii.)

### Operation of Aiming.

*Give the Lateral Sight Allowance.*—The laying apparatus being properly set in the socket of its support, plateau 0, tambour 100, the first operation consists in giving the initial lateral sight allowance that has been determined for the piece. The reading decided on is given by the captain to the chiefs of section and the layers gathered about him, or simply by command of the captain. Each layer then, in the manner previously explained, sets the index of the pedestal of the collimator, if necessary, and the micrometer-head (tambour) at the respective divisions indicated by the captain's directions.

*To Correct the Initial Sight Allowance.*—Bearing in mind the relation of the graduations of the plateau and tambour,* the following examples will illustrate this operation:

1. Initial reading, *Plateau 0, tambour 25*; add 5 millièmes; the layer turns the tambour to the division 55.
2. Initial reading, *Plateau 0 (or 16), tambour 25;* diminish by 85; the layer must first turn the pedestal by hand to plateau 14, then the tambour to 140 $(1625-85=1540=1400+140)$.
3. Initial reading, *Plateau 2, tambour 10;* add 450; the layer sets the pedestal at plateau 6 and the tambour at 60.
4. Initial reading, *Plateau 4, tambour 60*; diminish by 350; the layer sets the pedestal at plateau 0, then the tambour at 110.

*To Use the Collimator.*—The layer is instructed not to lean forward to look *through* the collimator, but to keep his eye as far from it as possible; he has to bring the target on the prolongation of the lignes de foi and so at their intersection. To do this it is necessary to close one eye, to look alternately in and outside the collimator by giving the head a rapid alternating motion from right to left and left to right to prolong the horizontal line and up and down to prolong the vertical line. In practice, usually, only the vertical line is considered as direction alone is wanted, elevation being given by the graduated range disk and level.

*To Give the Angle of Site.*—The layer simply turns the adjusting screw of the level until the disk reads the proper amount.

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* These terms are used in preference to the corresponding English translations as they are more specific, and in connection with the examples quoted, they make the context clearer. When used they always refer to the graduated base-ring and micrometer-head of the laying apparatus.

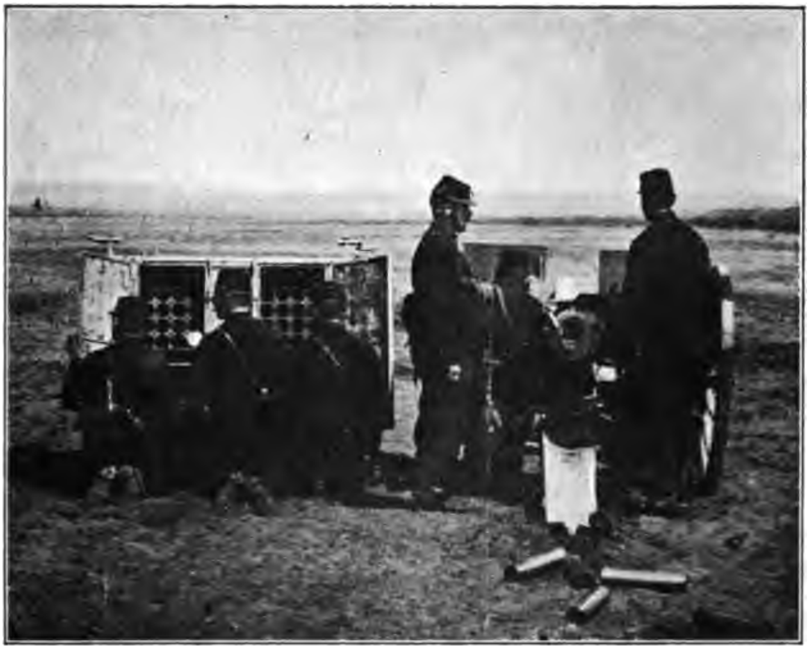


**Plate I. French 75mm. Field Gun. In battery rear view.**

— *Armée et Marine*, Sept. 14, 1902.

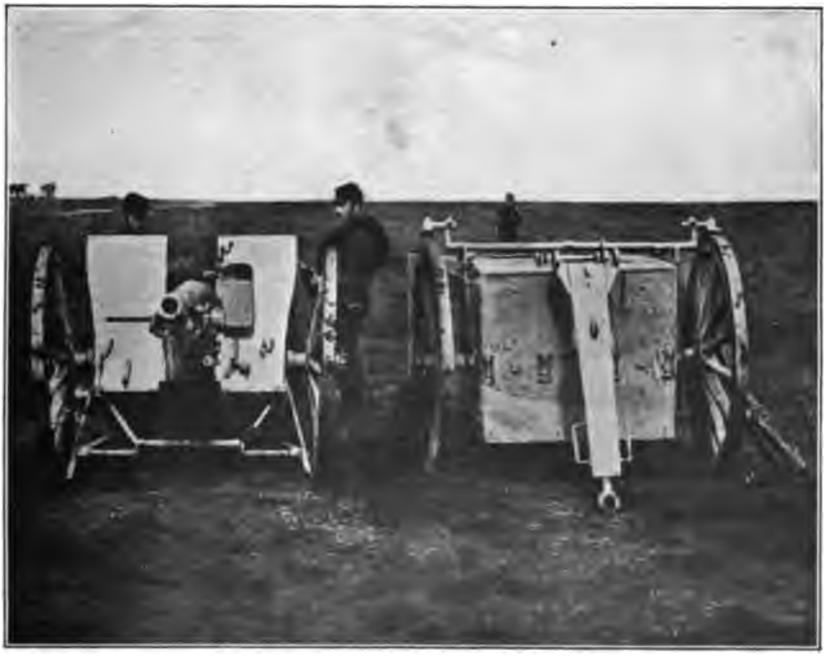


**Plate II. French 75mm. Field Gun. In battery, front view.**
**This plate shows clearly the articulation of the tyre brakes of the piece; also the small supplementary shield in front of the laying apparatus.**

— *Armée et Marine*, Sept. 14, 1902.

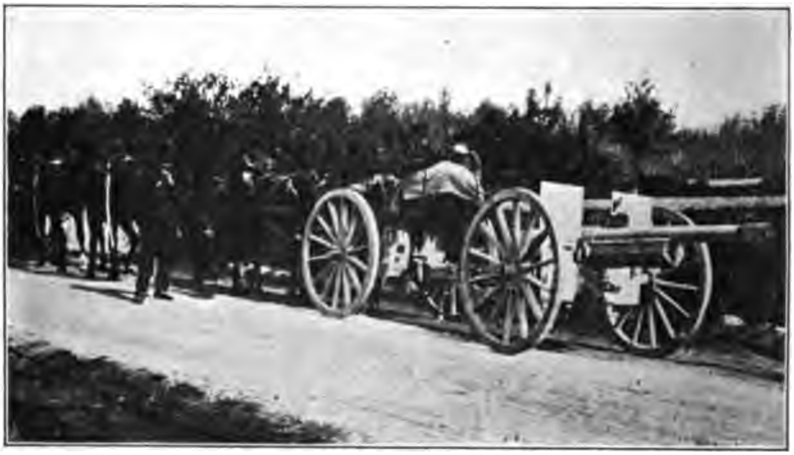


Plate III. French 75mm. Field Gun. On the road.

— *Armée et Marine*, Sept. 14, 1902.

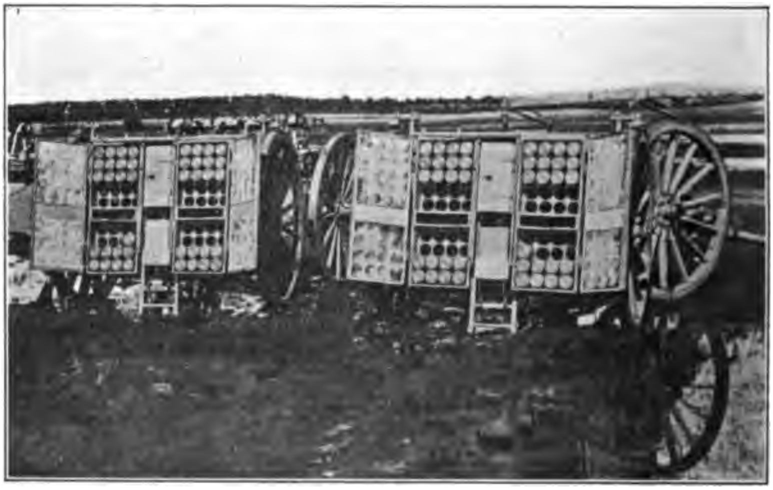


Plate IV. French 75mm. Field Gun. Rear view of caissons showing interior details.

In each, the two dark spaces between the chests are for drawers which carry various spare parts. The upper central compartment between the chests is for oats. The lower compartment contains the debouchoir, which is here hinged up for travelling.

— *Armée et Marine*, Sept. 14, 1902.

*To Lay In Direction.*—Laying in direction consists in causing the vertical ligne de foi prolonged to pass through the point of aim. The initial sight allowance having been properly set, the carriage is made to slide on the axle by turning the traversing handwheel in the proper direction with the left hand until the vertical line prolonged comes on the target. The layer should keep the piece always laid in direction.

*To Lay in Elevation.*—The firer sets the range disk at the determined range. The level having been set to the proper angle of site, the elevating handwheel is turned with the right hand until the bubble of the level is in its central position. On a moving target the prolonged horizontal line of the collimator is brought to the foot of the target by the use of the elevating handwheel and then the bubble of the level brought to the centre of its run by the adjusting screw. After the first shot, laying in elevation consists solely in bringing the bubble of the level to zero by the use of the elevating handweel.

*Laying in Direction and Elevation.*—In the case of a fixed target, the layer has to keep the gun laid for direction by means of the collimator and to keep the bubble of the level in the centre of its run. Except after the first round there is very little readjustment necessary. The gun is put to the elevation due to the range by the firing number who works the handle of the graduated disk on the right-hand side of the carriage. If the target is a moving one, the layer, instead of watching the bubble of the level, keeps the cross of the collimator continually on the object by means of the two handwheels on the left side of the carriage, all alterations of the gun due to change in range being given as before by the firer; the layer calls out "Ready" as he brings his lignes de foi on the object.

*Auxiliary Aiming Points.*—Except in the case of a moving target, if there is reason to fear that the point aimed at will not remain distinctly visible after the first aiming, or if the laying has been done by means of aiming pickets, the gun should be laid on some well-defined aiming point. It is advisable to select a point as distant as possible (1,500 metres or more) and to the right or left of the plane of fire and on the windward side of the target. This is done (the piece having been once aimed correctly) by turning the tambour until the vertical line prolonged coincides with the auxiliary mark chosen. The traversing handwheel must not be touched. If the divisions of the tambour are not sufficient for this, the pedestal itself is turned one or more divisions and then the collimator line is brought on the mark by turning the tambour. From this time on the collimator is directed on the auxiliary mark as though it were the object fired at.

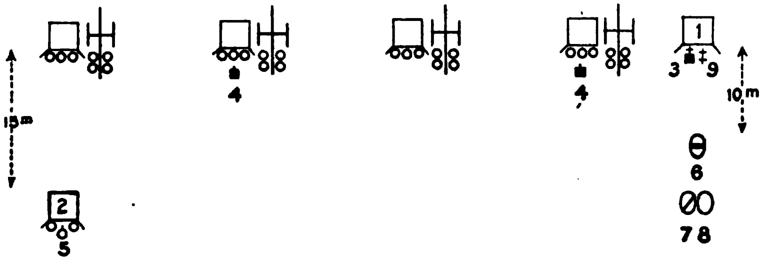
*Concealed Positions.*—If no distant aiming point can be seen through the collimator, even with two lengthening pieces, an aiming picket (carried on the caisson) is placed about 20 metres in front of the gun; the layer stands on his seat or on the gun, holding a plumb line, and causes the picket to be placed in the line between it and the target. If he is unable to see the target when standing on the gun or when on horseback, he may do so by standing on the caisson; his eye will then be about 10½ feet above the ground; he first gets the picket placed between the centre of the caisson and the target, the distance from the centre of the caisson to the gun is then measured and the picket is moved that amount to the side. Only one picket is required as the carriage does not move on firing. When one gun of a battery has been laid in the right direction, the others can be placed parallel to it by laying the guns horizontal, placing the lengthening pieces for the collimators and then measuring, by means of the collimator of the laid gun, the angle between the line from that gun to the picket or other object on which it may be laid and the line joining its collimator with that of the next gun. By adjusting the collimator of this next gun to the corresponding angle and then laying it on the collimator of the first gun, the second gun is brought parallel to the first.

If the target can not be seen from the battery at all, the guns may be laid by means of the battery telescope; this is placed so that the target can be seen through it and it can be seen from the guns. The tube supporting the telescope is placed approximately vertical and the telescope is directed first on the target and then on the collimator of each gun and the angles read off; the collimators of each gun are then set to a reading equal to 180 degrees minus the angle given from the telescope; the gun is then traversed till the collimator is laid on the vertical support of the telescope. The gun is then parallel to the telescope, and the collimator may then be laid on any other distant object, which can then be used as an aiming point.

FORMATION OF THE BATTERY.—A battery of 75 mm. guns on war footing consists of 4 guns, 12 caissons, 1 battery wagon, 1 forge, 1 forge wagon and 3 or 4 ration or baggage wagons.

In order to be able to fire rapidly there must be plenty of ammunition close by the pieces. For this reason an unlimbered caisson is placed on the left of each gun and 1 metre from it to facilitate ammunition supply. The bottom and doors of the chest are of chrome steel, the same as the shields on the gun, so as to protect the cannoneers. Behind the up-ended body of each caisson and the two leaves of the lid, the fuze-setter and the two men that supply the guns, all three on their knees, are as well protected as the layer, seated on the left of the carriage, and as the firer, seated on the right of the carriage, where he can change the range without disturbing the line of sight. Of all the cannoneers the loader is alone half exposed. The chief of piece, 50 centimetres in the rear of the right wheel of the gun, is exposed to the same extent as the loader. Chiefs of section (4) have their normal positions behind the caisson of their right piece.

Fig. 18. Formation of the Battery for Action.



A caisson body (1), placed upon the line of the pieces at the flank of the battery where the captain (3) is in command, furnishes the latter a shelter or place of observation. By the side of the captain the battery telescope is placed. At 15 metres behind the piece on the flank opposite to that where the captain is, the second caisson of the first reserve supply (2) is established, the caisson body being brought into action, and the limber being taken away. The interval between the pieces, generally about 14 metres, 16 metres from axis to axis, may be diminished or increased without falling below 2 metres or exceeding 30 metres. The limbers are sheltered. Such is the formation of the battery at the moment of firing with its four caissons for immediate supply and its two caissons for first reserve. Only a quartermaster's corporal (6), 10 metres behind the captain, is completely exposed, and a bugler (7), a few metres behind the corporal, holding the captain's horse.

*Duties of Officers.*—The commandant of the divisional artillery fixes the zone of action of each of its groups, indicates those who will open fire or who will put themselves into positions of observation, or in a position of waiting, and designates the objectives. The commandant of the group divides up the objective among the batteries; he designates, if there is any reason for it, those who are to open fire, or who will put themselves into positions of observation or positions of waiting, and fixes the zone of each. The commandant of a battery who is called upon to open fire determines the initial elements for firing, that is, the range, the angle of site, and, if possible, the lateral sight allowance. He defines the objective, and indicates, when the kind of fire allows it, the point of aiming. The commandant of the battery in the position of observation studies the zone of action in which the group to which he belongs is to act, or only the zone which is assigned to him, if there is reason therefor. He determines the elements of firing corresponding to the most probable positions of the objectives, in such a way as to be able to open fire upon them as rapidly as possible when they become visible. Generally speaking, the brake shoes are not lowered.

*Preparation for Firing in a Position of Observation.*—Preparation for firing by artillery in a position of observation demands, above all, the procuring in advance of all the initial elements of fire corresponding to prominent points of the terrain in whose proximity there is a probability of seeing objectives appear. It is necessary, moreover, that the guns may be disposed in such a way beforehand that at the moment of the appearance of the object the fewest operations will be required. The captain then can then arrange the pieces in three distinct systems: convergence, parallelism, fan-shaped.

1. Convergence.—To obtain without lowering the brake shoes convergence of fire upon a point in the direction of the axis of the zone of observation. At the appearance of the objective to bring the fire upon it and prescribe the necessary echeloning.

2. Parallelism.—To establish the guns parallel, the axis of the first piece being directed upon a point toward the middle of the zone of observation. At the appearance of the objective to move the parallel system by an amount equal to the angular distance from the plane of fire of the first piece to the right of the objective. To lower the brake shoes and open fire. This proceeding is of great simplicity and is frequently employed, for it generally permits covering in all its extent with the first salvo a front equal to the front of the battery, by means of a single operation which consists in giving a uniform correction for lateral sight allowance for all the pieces.

3. Fan-shaped.—To arrange the bundle of planes of fire in fan shape, directing the first piece upon a mark as near as possible to the direction that is chosen for this piece, and in echeloning

the lateral sight allowances 15 millièmes apart in such a way as to establish planes of fire in divergent directions more and more distant from those of the first piece. To go into action as soon as the objective appears. This arrangement permits the battery to cover instantaneously with a small number of pieces a large objective appearing unexpectedly. To direct upon the objective the whole number of pieces it is often suitable to correct the echeloning. When the zone of observation exceeds the front that the battery can cover with sweeping, it is preferable not to lower the brake shoes. Nevertheless, it is always necessary to drop these shoes beforehand when one has a defile under observation and when this point of defile can be entirely held under fire.

Group.—If the zone of observation, which is the ordinary case, is not divided between the batteries of a group, each battery ought to be in such a position that the indication of a simple angular distance from a prominent common point which is well known by all the captains, will be sufficient to permit one or several batteries to open fire without delay upon determined points of the zone of observation. This point must be found in the neighborhood of the axis of the zone of observation.

[To be continued.]

# THE DIFFERENCE CIRCLE PLOTTING BOARD.

By First Lieutenant P. C. HAINS, Jr., Artillery Corps.

The extended application of the difference circle to the plotting board has never, so far as I know, been fully developed.

In the following it is believed a useful combination has been made which will insure not only all reasonable accuracy, but considerable celerity and ease in plotting when using the horizontal base line.

A scrutiny of the increase in distances between two difference circles, measuring any two given azimuth differences, for different lengths of the base, will at once suggest the special applicability of this method to extremely short bases, such as are now being considered for adoption.

Numerous combinations including this principle suggest themselves in actual practice, but such enumeration would entail the discussion of the horizontal base system of range finding.

It has been the aim, in the method to be described, to simplify the board by doing away with as many rulers, etc., as possible, thus quickening the work and lessening confusion. The object has also been kept in view to render, as nearly as possible, uniform accuracy all over the board.

For this reason the difference circles are spaced more closely together as the range increases, and correspondingly the errors increase due to errors in plotting by azimuth.

On the chart "BC" is the base line and "A" the directing gun, situated near it.

A series of azimuth difference circles are described about "BC." There is an azimuth scale on the chart for the Station "B" and one for the gun "A." At "B" is a small pin to which a fine black silk thread is attached. (or if preferred a ruler pivoted at "B" may be used).

At "A" is pivoted the usual scale ruler for the gun, appropriately graduated for range.

Two simultaneous readings on the target being sent in from "B" and "C," the reading at Station "B" is substracted from the reading at Station "C," this difference in azimuth together with the azimuth of the target from "B" is given to the plotter.

The plotter laying the thread, by means of the azimuth scale provided, to read the azimuth of the target from "B" and plac-

ing his pencil point *along* the thread at the given azimuth difference, as shown by the difference circles, locates the target.

The target is then referred to the gun by means of the gun ruler and corresponding azimuth scale, as in the usual method.

It is readily seen that both plotting and predicting may be carried on in the usual manner when so desired.

In making an actual construction both the centre of each difference circle and its radius can be calculated with absolute accuracy; and with appropriate instruments and material to work with, as accurately laid off and the circles constructed. The work is thus perfectly true both mechanically and mathematically and is without distortion or approximation of any kind. The desired degree of accuracy for the board is attained by putting in the difference circles sufficiently close together. To give the chart the same accuracy throughout, it is evident that at close ranges these circles need not be spaced so as to give such close readings as at long ranges.

By a system of colors on a chart now constructed, I have found great ease in making quick readings.

On this chart only the circles denoting whole degrees are drawn in black and numbered. Thirty minute circles are drawn in red, fifteen minute circles in yellow, ten minute circles in blue, five minute circles in green, etc.

The ideal board would be a sheet of white vellum, the circles drawn in brilliant colors as above described, with the numbers of the black degree circles stamped over them in large figures about three-eighths of an inch in height, and in some light tint that will not obscure the circles.

A marked advantage possessed by this method of plotting over the method of the intersection of the azimuths read at the base ends, is that at no matter what range, the azimuth difference is always read readily on the circles, thus doing away with locating points by means of oblique intersections.

The manipulation of the board has been found easy to explain to the enlisted man, who, after but a single demonstration, is generally able to plot with accuracy.

# PROFESSIONAL NOTES.

## ARTILLERY MATERIAL.

### Test of the New 16-Inch Gun.*

Not since the Armstrongs made their memorable test with the 16.25-inch gun, built by them for the British navy, has there been a trial of heavy ordnance to compare in spectacular interest with the test of the new United States army 16-inch gun, which was successfully carried out on January 17, at the Sandy Hook proving ground. We use the word spectacular advisedly; for, although the construction of modern ordnance is a matter of the coldest kind of calculation, and the gentlemen who design the guns have a wholesome horror of sensationalism, the achievements of these, the most potent engines of destruction known in modern life, will always in the public mind be estimated from the sensational standpoint.

From the accompanying table it will be seen that the great Armstrong gun is of slightly greater caliber; yet the reader must beware of making hasty deductions from this fact, and supposing that it is, therefore, a more powerful piece. Diameter of bore is but one of many elements that go to determine the energy of a gun. The strength of the gun steel, quality of powder, weight of projectile, muzzle velocity, each of them has its say in the matter of the ultimate power of the gun; and for these reasons the new army gun is a vastly more powerful weapon than its Armstrong prototype.

Comparing the two guns, then, we find that the new weapon is 6 feet longer over all, 19½ tons heavier; that its projectile is 600 pounds heavier; that because of the better quality of powder that has been developed during the intervening fifteen years since the Armstrong gun was built, the 16-inch gun requires only 640 as against 960 pounds of powder for a full charge, but that with this smaller charge the heavier projectile is propelled with a velocity greater by 219 feet per second, giving a muzzle energy greater by 33,610 foot tons. The direct test, however, of the relative efficiency of the two guns is the amount of energy developed per ton-weight of the gun itself, and this for the Armstrong gun of 1887 is 492 foot-tons, and for the United States 16-inch gun 677 foot-tons. As the 16-inch gun was designed several years ago, we give for purposes of comparison the data of a 12-inch modern high-velocity gun built by Krupp, with a velocity that brings the energy above that of the Armstrong gun of double the weight.

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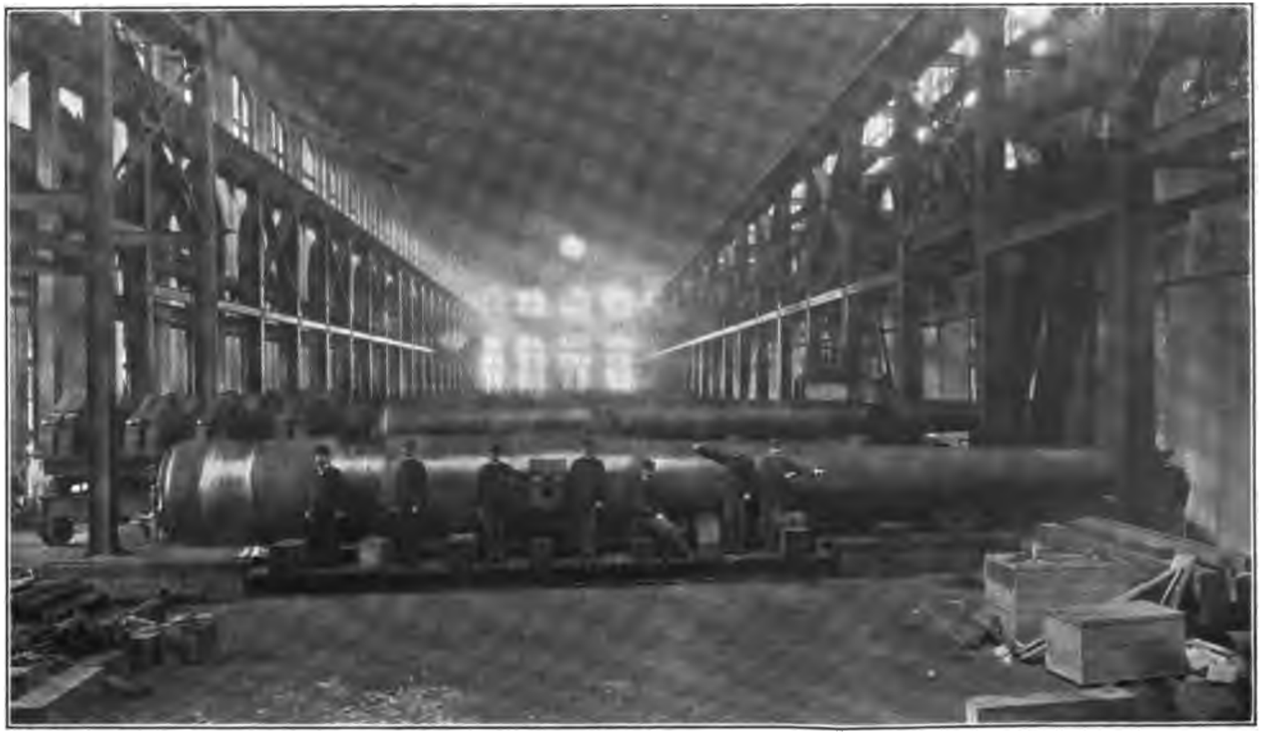
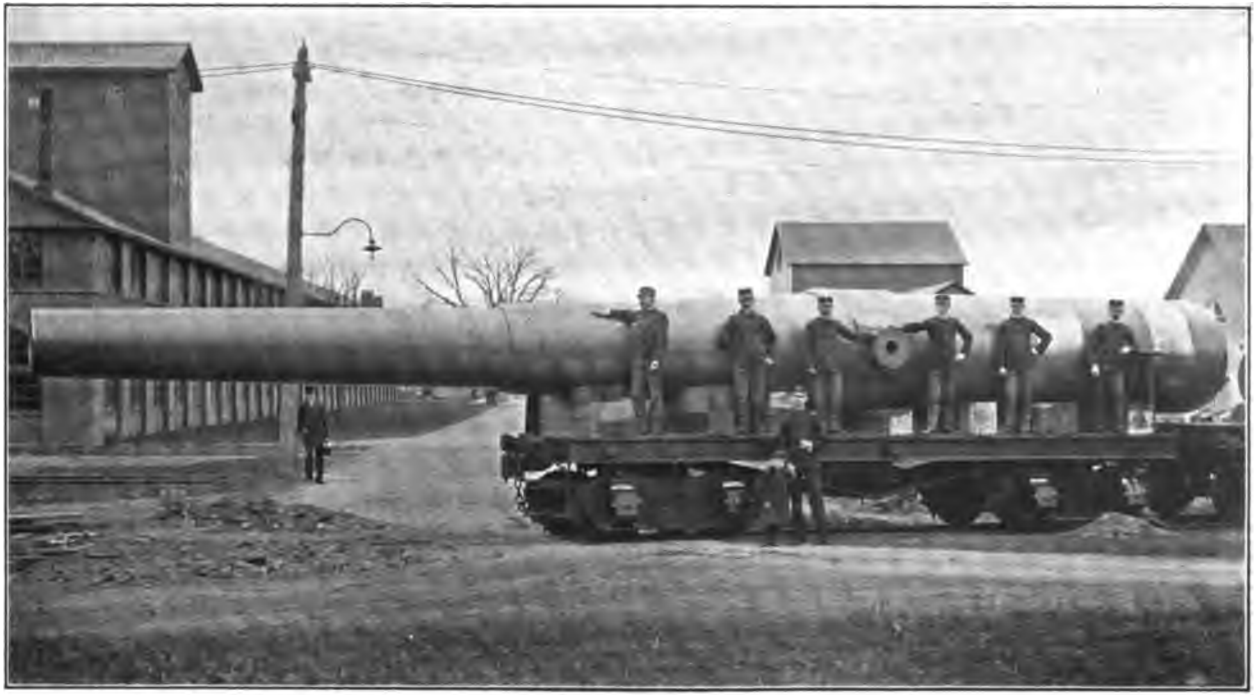
* For a complete description of this gun, and details of its construction, see *Journal U. S. Artillery*, May-June, and July-August, 1901; Vol. XV, No. 3; Vol. XVI, No. 1.



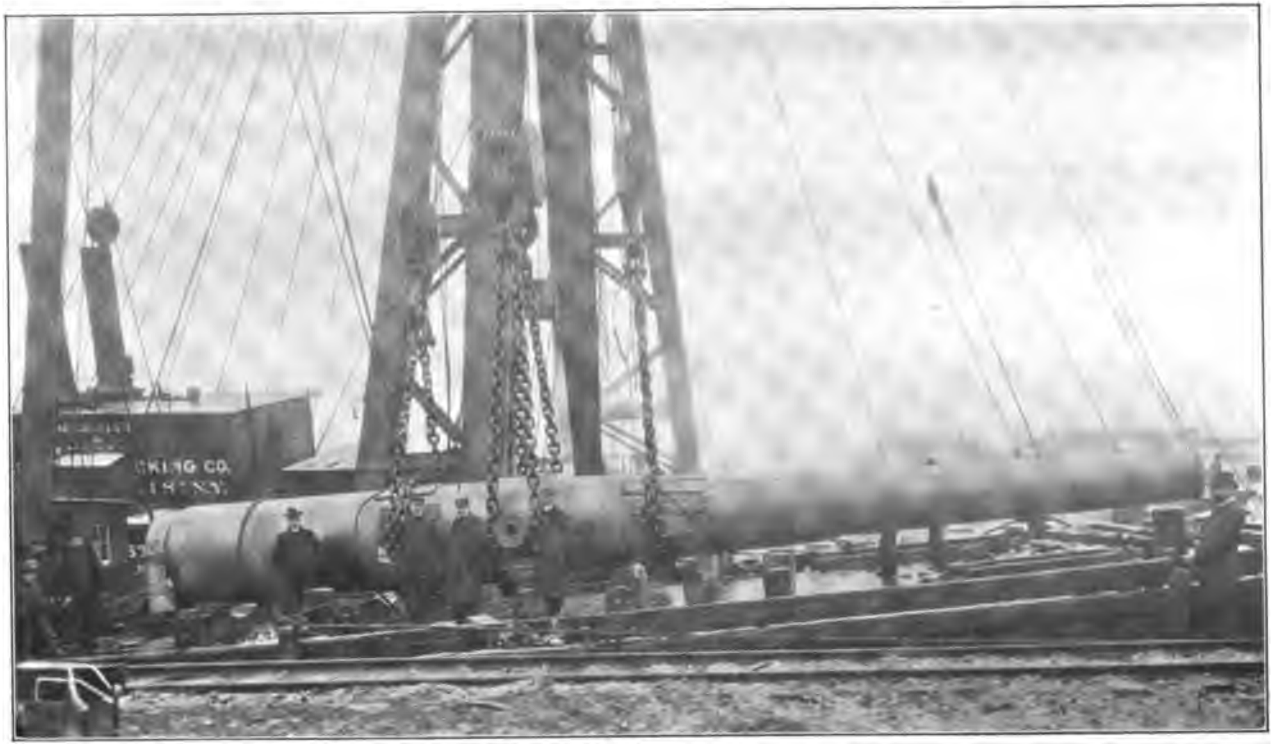
**The 16-inch Gun.**

Leaving the arsenal.



**The 16-inch Gun.**

On the way to the dock.



**The 16-inch Gun.**

On Lighter for transportation to Sandy Hook.

| Type of Gun. | Bore in inches. | Total length in feet. | Weight in tons. | Weight of projectile in pounds. | Weight of powder in pounds. | Kind of powder. | Muzzle velocity in feet per second. | Muzzle energy in foot-tons. | Muzzle energy in foot-tons per ton weight of gun. |
|---|---|---|---|---|---|---|---|---|---|
| Armstrong | 16.25 | 43.5 | 110.5 | 1800 | 960 | Slow burning cocoa. | 2087 | 54,390 | 492 |
| U: S. Army | 16 | 49.7 | 130 | 2400 | 640 | Nitro-Cellulose Smokeless. | 2306 | 88,000 | 677 |
| Krupp | 12 | 50 | 57.6 | *771.6 | 334 | Nitro-Cellulose Smokeless. | *3330 | 59,289 | 1029 |

* In this comparison it must be remembered that the velocity falls off much more rapidly in the lighter shell; so that the "remaining velocities" will be proportionately greater in the 2400-pound projectile than in the case of the other two.

The test in January served in every particular to establish the accuracy of the calculations on which the construction of the gun was based. Army gun construction has been eminently successful from the very first; and while the ordnance experts had no doubt as to the behavior of the gun under trial, there was, as General Crozier, Chief of the Ordnance Bureau, stated before the gun was fired, a certain measure of uncertainty introduced, because of the very size of the gun and the unprecedentedly large charge of powder that was to be fired. "Before we go on with the tests I want to give you a few figures by way of comparison. The 12-inch gun weighs fifty tons; this gun weighs 130 tons, and while the former uses a projectile weighing 1,000 pounds this

Loading the Six 107-Pound Bags of Powder Into the Breech.

gun carries one weighing 2,400 pounds. While the velocity may be said to be the same approximately, the relative power may be said to vary with the weight of the projectile. It may be put at two and four-tenths more powerful. We feel that we can say of this gun as it stands, that it is further ahead of the 12-inch gun, than the 12-inch gun is ahead of the 10-inch gun. In building it we have taken a bigger step forward than has ever been taken with any piece of ordnance that has preceded it.

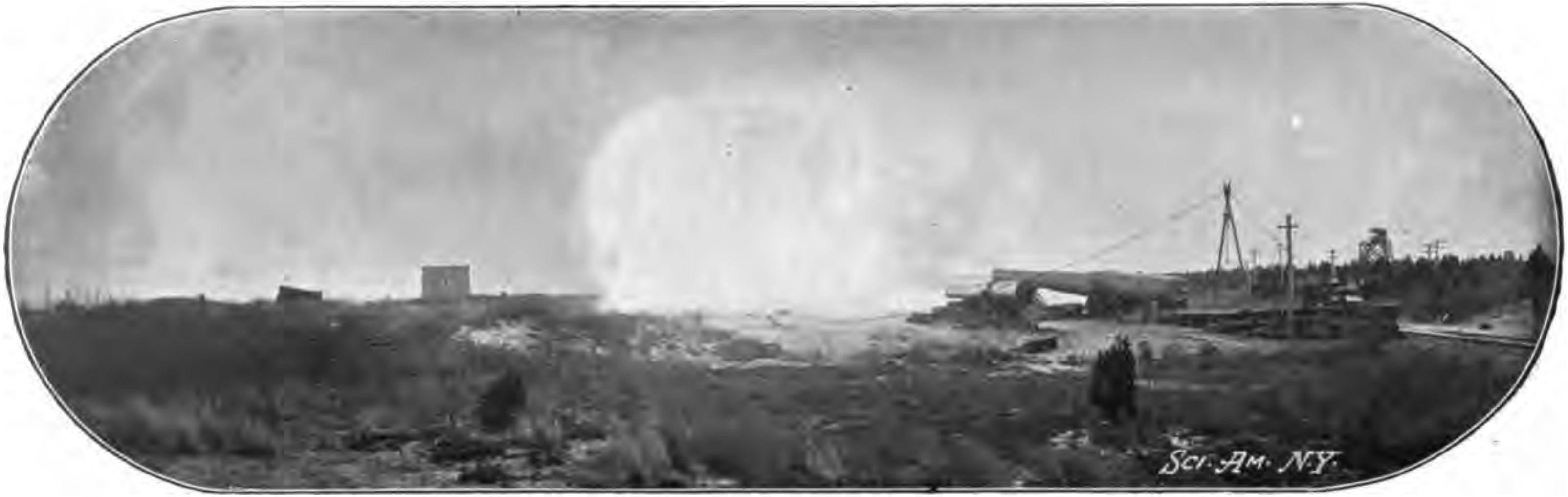
"I wish to say that the principles involved in this gun, its design and construction are due solely to Colonel Farley, Major Birnie and Major Smith. They divide the credit for this piece of ordnance among them. When we test this gun to-day we are going beyond any point ever reached before. We will fire from it a larger charge of smokeless powder than has ever been fired from any gun. It may be that it will generate heat so great that the powder will not behave itself. If that is the case we will not, of course, get the results we are looking for. It may be that such a tremendous charge will be enough to demolish the gun. We do not know what may happen. This is purely a test and it is a test without a precedent. We have figured the thing out as well as we can and on the maximum charge of 640 pounds of powder which we will use on the second and third shots, but not on the first, we look for a velocity of 2,300 feet per second and a pressure 38,000 pounds to the square inch".

In the process of loading, a 2,400-pound shell was brought up to the breech on a truck and rammed home by the united efforts of some twenty men on the rammer, fetching up in the lands with a "chug" that made even the 130-ton mass tremble. The powder was then loaded into the breech in six canvas bags, each carrying about 107 pounds, the last bag having in its center several pounds of fine-grained, quick-igniting powder, to make sure of the ignition of the charge. It should be mentioned here that a special bed of concrete 10 feet deep, 12 feet wide and 30 feet in length had been prepared for the reception of the gun, and the mount used in testing the 18-inch Gathmann gun, which lay alongside, was bolted to this platform, and proved equal to its heavy duty. Although calculation has been made as a mere matter of interest of the maximum range of the gun at an elevation of over 40 degrees, no attempt was made to throw a shell to the estimated distance of 21 miles. As a matter of fact, the elevation was only about 1½ degrees for the first two, and 4 or 5 degrees for the third round. From the spectacular point of view, the discharge must have been disappointing to those who were looking for sensations. The report lacked the sharpness and angry snap of an 8-inch or 10-inch piece, and the concussion was of the mildest. The rush of flame extended perhaps for 100 feet in front of the gun, and the smoke of the ignition charge of black powder mushroomed out and drifted lazily away to the westward. The shell struck a few thousand yards out to sea, throwing a vast column of spray heavenward and ricocheted, twice, sharply to the right before sinking below the waves. The first charge consisted of 550 pounds of powder, which gave a powder chamber pressure of 25,000 pounds to the square inch, and a muzzle velocity of 2,003 feet per second. The second charge of 640 pounds raised the chamber pressure to 38,000 pounds and the muzzle velocity to 2,306 feet per second. The third shot, because of the elevation of the gun, passed clear of the velocity screens and no velocity was taken.

This successful trial of the 16-inch rifle has converted into advocates for such ordnance many in and out of the Ordnance Corps, who were at least doubtful as to the expediency of building guns of this caliber. The big gun

The Breech Mechanism, Open.

Twenty Men Ramming Home the 2400-pound Projectile.



Instantaneous Photograph of the Discharge.

not only realized the most sanguine expectations concerning it, but it furnished a complete vindication of the accuracy of the advance calculations of Colonel J. M. Ingalls, U. S. A., retired, as to what it would accomplish, which had been called in question by foreign experts. The greatest elevation of the gun on the proof carriage is four degrees. Taking the initial velocity of the 2,400 pound shot at 2,300 f. s., the computation by Ingall's formula, gave a theoretical range at this elevation of 6,387 yards. In the trial of the gun, observations from the base end stations showed an actual range of 6,350 yards, or within 37 yards of the computed range; a difference of less than six-tenths of one per cent. Ingalls computed the extreme range, with the same weight of shot and the same initial velocity, at 20.9 miles. Allowing the same per cent of difference, and the actual maximum range should be 20.691 miles, or one-half of the distance between Washington and Annapolis. The artillery will be delighted to find Ingalls' formulas so reliable. Foreign ballistic experts claimed that his calculations were some miles in excess of the possibilities of the gun.

When the 16-inch gun was fired with an elevation of 1 degree, 25 minutes, it ranged 2,500 yards. The loss in velocity of the 16-inch projectiles for the first 450 feet was not over 17 feet, or about four per cent of the velocity over the same initial space of 450 feet. This is due to a fact which should be emphasized in this connection, this is, that sectional density, or ratio of weight of projectile to area of cross section, increases with the caliber. Comparing the sectional densities of the 12-inch and the 16-inch projectile, both of the same form, we find that they stand in the ratio of eight to twelve in favor of the 16-inch.

This is a great gain in effectiveness over the 12-inch gun, and the Chief of Ordnance, General Crozier, is quite correct when he states that the successful performance of the 16-inch gun at Sandy Hook, if it does not lead to the manufacture of more guns of like caliber, will at least result in the building of a gun of caliber intermediate between the 16-inch and the 12-inch, or say 14 or 15 inches. This intermediate gun will probably be the next in order. All artillerists know what flat trajectories signify and the value of the recorded performance of the new gun.

General Crozier is quoted as saying at the conclusion of the trial at Sandy Hook: "The tests that have been made to-day have demonstrated that if guns like this are ever needed by this country they can be turned out successfully here. When a gun has handled the largest charge of smokeless powder ever put into a gun, as this one has, it is safe to say that it is an absolute success. Everything has worked to our satisfaction. There was a lot of trouble making this gun, and there were many ways in which it might have been a failure. The breech might have blown out or become jammed, but, thank goodness, nothing did happen, and the tests have been a success. Of course, there is a lot of work to be done yet. The bore must be measured with a star gauge to see if the tremendous explosion has caused any permanent expansion. If there is any expansion beyond a few hundredths of an inch it would mean the failure of the gun. This gun is something new in ordnance, and after to-day I can safely say that it has come to stay. These tests show one thing, and that is that this gun can be fired with accuracy so as to hit an enemy's vessel at from five to seven miles and can get an extreme range of as far as twenty miles, which is much greater than any gun has ever attained."
—*Scientific American*, January 31, 1903 and *Army and Navy Journal*, January 24, 1903.

### War Material, 1902.

During the past year no improvements of importance in armor-plate manufacture have been recorded. With one exception, all naval powers continue to use for the bulk of their requirements the nickel-chrome steel plates specially treated, which were introduced some six years ago by the firm of Fried Krupp, of Essen. The exception is France, where a steel of somewhat similar character, but differently treated—introduced by the firm of Chatillon Commentry, and said to give as good ballistic results as the Krupp process steel—is employed.

Face-hardening by cementation, followed by chilling, is universal. The ingots are made in open-hearth furnaces with either acid or basic linings, and the forging is done in some places by the rolling mill alone, in others by the hydraulic press alone, and in others, again, by a combination of pressing and rolling. The particular method of cementation is also immaterial, it being as often effected by keeping illuminating gas in contact with the heated plate as by the solid carbon method patented by the late Mr. Harvey. In all cases the endeavor is to get the hardest possible face in combination with the toughest possible back, the former being obtained by super-carburising, followed by chilling, and the latter by the selection of a suitable composition for the steel, and subjecting it to proper treatment. For armor of less than about 4 inches thick, however—or of any thickness, with exceptionally great curvature—the usual methods of combining hard face and tough back present too great difficulty in execution, so that for plates of this class the glass hard face is dispensed with, and a simple nickel steel treated so as to be tough throughout is the material commonly employed. Against projectiles of 4-inch caliber and upwards, with naked points, the hard face of modern armor adds very substantially to its resisting power, since, although the face of the armor can never be so hard as the point of the projectile, the latter is delicate and easily broken when unsupported laterally, as at the moment of first impact. This delicacy decreases with the caliber, so that small projectiles, such as the 6-pounders and 12-pounders for example, seem to be little affected by a hard face. From this it would appear that armor intended to be proof only against the very small calibers might as well be tough throughout. Experiment has endorsed this view in the case of shot striking normally, but it would be instructive to determine whether a hard face to thin plates is not valuable against oblique attack. Such plates, it is understood, could be made if called for, say one inch thick, or less, for torpedo boat decks.

In the case of larger projectiles the lateral weakness of the point is now being met by attaching to it a cap whose function is to give at the moment of impact the lateral support that the walls of the indent in the armor afford as soon as the shot has made good its entry. It is interesting to note in this connection that a glass-hard face can be actually indented without splintering with a first-class punch, if the latter is furnished with a little cap, say, of boiler plate. The idea of capping projectiles was first hit upon at Shoeburyness many years ago, but it was long held that the liability of the cap to come off, the extra resistance it offered to flight through the air, its presumed interference with accuracy of shooting, and its doubtful utility on oblique impact, were disadvantages that outweighed its merits.

The Russians in 1894 were the first to give practical effect to the opposite of this view, and since then improvements in the caps and their method of attachment have minimized their disadvantages and caused their value to be recognized by all nations as a means of increasing the offensive power of artillery against armor. As an example of the assistance to perforation afforded by the use of a cap, it may be roughly stated that a capped 6-inch projectile of 100 pounds may be expected to perforate a 6-inch Krupp process plate at under 1900 foot-seconds, while, uncapped, it would be stopped by the same plate up to about 2200 foot-seconds, and this latter velocity would carry it, if capped, through at least an 8-inch plate of the same quality.

A comparison of the results obtained by capped and uncapped projectiles against Messrs. Vickers' 12-inch plate in May last* puts quite beyond doubt the fact that a cap enables a projectile to retain its point on impact with a hard face, and so to get the increased penetrative effects that its ogival pointed form is designed to give. Of the two 6-inch rounds fired without caps each had a calculated perforation of about 23¼ inches of wrought iron, but the shots' points were pulverized against the face of the plate, and they achieved only a trifling amount of penetration, while the two capped 6-inch projectiles, having substantially the same calculated perforating power, traversed the whole thickness of the plate, one being broken up and one apparently entire. The 7.5-inch capped round had a calculated perforating power of 24 inches wrought iron, and, judging from the 6-inch results, this might have been expected to get through; but increase of caliber in a projectile is usually attended by decrease of strength, and so, though the cap served its purpose in this case, as in the others, of preventing the pulverization of the point at the first instant of impact, a general collapse of the shell took place too early to allow it to conquer completely the plate at the stated velocity. A very good plate of this class and thickness, such as the one in question, might have a figure of, say, 2.4—that is, it might just stop an uncapped shot calculated to just perforate wrought iron 2.4 times thicker. This means that the striking velocity of the uncapped rounds might have been increased to over 3200 foot-seconds before they conquered the plate, and yet, with the cap, about 2800 foot-seconds sufficed. In other words, the cap was worth about as much as 400 foot-seconds extra velocity.

The importance of the cap, however, must not be overrated, since the great desideratum from the point of view of the attack is to cause shells containing high explosives to perforate intact an enemy's armor and then to burst inside it, while it does not appear to have been clearly demonstrated by experiment that a cap will enable this to be done. Cap experiments are usually made with shells loaded with salt, and not with an explosive, and it is not safe to infer that because a shell containing salt can be forced intact through an armor plate, that the result would be the some if the salt were replaced by lyddite, which would probably detonate at the instant of first impact, and prevent any substantial penetration of the projectile at all. Moreover, if the shell containing lyddite could be got intact through the armor, it would then require to be burst by a very special delay-action fuze. Such a fuze may be in existence, and some means of preventing the high explosive from detonating prematurely may have been discovered, but, if not, all that can be expected from a cap is that it will enable a non-explosive projectile to perforate armor that would otherwise be proof against it. This naturally would be far more desirable from the attackers' point of view than no perforation at all, so it must be conceded that the cap system deserves the closest study and most exhaustive experiment. Our own Admiralty have made many experiments to determine the practical value of caps, and the experience thus gained has had its due influence on the regulations of the service. Against soft armor, of course, the cap is not only useless but, *pro tanto*, obstructive, and, in any case, its utility diminishes rapidly with obliquity after the angle of impact exceeds about 20 degrees with the normal.

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* See *Journal U. S. Artillery*, September-October, 1902.

For the attachment of the cap to the shell's point various methods are in use. The Johnson cap, for instance, is pressed into a continuous groove made round the nose of the projectile, while Hadfield uses a projecting rib or a series of shallow depressions instead of the groove.

It seems to be becoming more generally recognized that ships with unarmored ends are at a great disadvantage, and a complete belt from end to end will probably be the rule in battleship design pending further developments.

We would draw attention to what appears to us a danger in the practice which has generally prevailed, in this country at least, of testing only armor for resistance to perforation, and not armored structures for resistance to deformation. The number of guns protected by casemates on British ships is very large, and no doubt those guns and mountings are as well protected from the actual contact of projectiles as the alloted weight of armor permits; but the clearances between the inside of the casemates and the mountings are very small, and it is not certain that a blow much less severe than necessary for perforation would not deform the structure sufficiently to jam the gun and effectually put it out of action. The casemate wings also, which are supported only by one of their edges, as by a rigid steel hinge, would be likely to shift considerably with quite a slight blow, and if they then got in the way of the gun it would even be preferable that their attachment should be purposely much weaker, that they might, if not carried completely away, be easily removed by the crew of the gun.

Barbettes with small clearances may be equally a fallacious protection, and we think it should be a rule that where clearances are not obviously ample their sufficiency should be tested by actual firing against the structure itself. No doubt this would be expensive, but, if our apprehensions are well founded, the information obtained would be cheap at any price.

It is to be noted that nickel has of late years become an almost indispensable ingredient of steel for armor of all classes. It is also much used abroad, and probably soon will be in this country, for gun steel, and altogether its importance for war material has necessitated the taking of steps to ensure that supplies of it should be forthcoming in time of war. To this end all British armor-plate making firms have locked up a large amount of capital in stocks of nickel; and though New Caledonia practically supplies the world at present with nickel ore proper, Canada fortunately produces large quantities of copper ore rich in nickel, which experiment has shown can be smelted and refined to produce, though at a somewhat enhanced price, a metallic nickel suitable for armor-plate. So much of our raw material for war purposes comes from over sea, that even if the United Kingdom were completely self-contained in the matter of food supply, command of the sea would still be necessary to our continued existence as a nation.

Concerning guns there is really nothing new to record. The evil of scoring continues, and it is not improbable that cordite will have to be abandoned on this ground in favor of some of its rivals. We have recently said all that can be said for the moment about developments in the construction of torpedoes.

—*The Engineer*, January 2, 1903.

### The Grenfell Sighting and Signalling Gear.

Immediately before a patent was applied for in England by MM. Schneider and Canet, of Paris (commencement of 1901), for a new type of sighting device with independent rear-sight, Captain Hubert Grenfell, R.N., made an application at our Patent Office to cover a similar device invented by him, the object of which is identical with that aimed at by the French inventors—namely, the reduction to a minimum of the duty demanded of the gunner. With this device the gunner has simply to fire the gun at the instant his sights come in a line with the target, a second man having meantime corrected the aiming for range. The French device has been adopted with great success for field and siege ordnance.

All artillerists—and chiefly, perhaps, those who have given special attention to land artillery—are clearly of opinion that, given two opposing batteries of approximately equal value, the one able to fire in a minimum time the largest number of rounds is practically sure to silence its opponent. This consideration has greatly conduced to the almost general use of cartridge-cases by the Continental armies and navies. In this conclusion they may have erred too much on what they considered the safe side; but this remains to be proved. We know, however, that the French artillerist eagerly adopted the sighting device with independent rear-sight, as a means to secure the desired end with greater rapidity and a higher degree of accuracy.

In naval encounters the object will evidently be similar, and the successful fleet will in all probability be the one that is able to ensure a maximum use of its ordnance within the first few minutes after the opening of an action. In Captain Grenfell's opinion, embodied by his sighting device and signalling gear, this success depends on the three following main points:

1. The mechanism for aiming should provide throughout for the conditions under which a gun is fired at sea; and this mechanism should fulfill all the conditions in the fullest, most rapid, and most accurate manner.

2. The control of the fire should be absolute on the part of those in whom the conduct of the action is vested, and the communications between the commanding officers and all the various components which make up the artillery of the ship should be direct, immediate, and continuous through all the phases of an action.

3. The highest skill and experience that can be obtained should be available on the part of all concerned in the use of the guns and accessory gear; the mechanical appliances should be simple, not easily disarranged, and suited to the special requirements of modern naval artillery practice, in order to produce accurately, and in a minimum time, the desired results.

Figure 1, reproduced from a photograph, shows the Grenfell sighting gear fitted to a 6-inch gun on board H.M.S. *Narcissus*. The device consists of a series of differential gearing actuated, as can be seen from the illustration, by two hand-wheels, one of which is held by the firer while his eye remains on the sight, the other wheel being worked for correcting the aim for range by another number, called the sight-setter. The gearing acts as follows: the firer, by operating his wheel, aligns the sight and the axis of the gun simultaneously on the target. The sight-setter at the same time alters the axis of the gun in relation to the line of sights, or, in other words, he increases or decreases the elevation of the gun for range without altering or disturbing the line of sight in any way. The axis of the gun is turned in relation to the sight, instead of turning the sight in relation to the axis of the gun, and then moving the axis of the gun to re-align the sight, as in present practice. Both these operations can be carried out simultaneously or independently of each other, neither interfering with the result required by each operator. If one only of the hand-wheels be turned, the axis of the gun fully answers the single action with regard to the sight. When, however, the two hand-wheels are operated together, the gun axis answers the double action in a measure exactly equal, according to direction, to the difference between, or the aggregate of, the motions due to the double action. The resulting position for the gun axis, in the latter case, is exactly that which would be taken up were the two hand-wheels to be worked in succession, to the same extent, instead of simultaneously.

The result desired by the firer is the alignment of the gun axis laterally, and in elevation, to insure hitting the target; and this is ensured when the range is known, and the sight adjusted for that range, by bringing the sight upon the target (and with it the axis of the gun) at a constant angle with this line. The duty of the sight-setter is the exact adjustment of the angle between the axis of the gun and the line of sight, or, as already stated, the correcting of the aim for range. The firer can therefore keep his eye constantly along the sight, and by working his hand-wheel and bringing the line of sight on the target, he lays the gun correctly, while the setter is continuously altering the elevation for range without disturbing in any way the line of sight. The attention of the firer is concentrated upon the sole duty of discharging the gun at the very instant his sight-line is on the target. The rapidity and accuracy of firing are greatly increased thereby, as has been amply proved by the successful practice with the Schneider-Canet device.

The considerations governing the design of this mechanism are as follow:

To obtain accuracy and rapidity of fire, three conditions have to be satisfied:

1. The sight must be on the target when the gun is discharged.
2. The sight must be correctly adjusted at the moment of firing.
3. The gun must be discharged immediately the loading is completed.

To satisfy these three conditions two distinct operations have to be performed, and each in its most perfect manner.

These operations are:

I. The pure physical one of *aligning the sight and firing the gun.*

II. *The control of the angle between the* "*axis of the gun*" *and the* "*line of sight,*" in accordance with momentary requirements.

Under modern conditions of gunnery the perfect performance of these two operations means:

(*a*) *Keeping* the sight *aligned at all times*, thus ensuring that the gun is discharged when the sight is on the target by eliminating personal error, and that it is on the target when the loading is completed.

(*b*) *Keeping* the sight *adjusted at all times*, thus ensuring that the adjustments of the sight are correct at the instant of firing.

To *keep* the sight *always on the target*, is an exceedingly difficult and delicate operation, and demands the undivided attention of those engaged in it, and that they should not be hampered by any other consideration or disturbing cause whatever.

To *keep* the sight *adjusted* from moment to moment can only be done from careful observation of the fall of shot, and of the rate of change in the range, etc. To make the first estimation of the adjustments, to correct these from the fall of shot, and to accurately estimate the rapid changes in range, etc., in

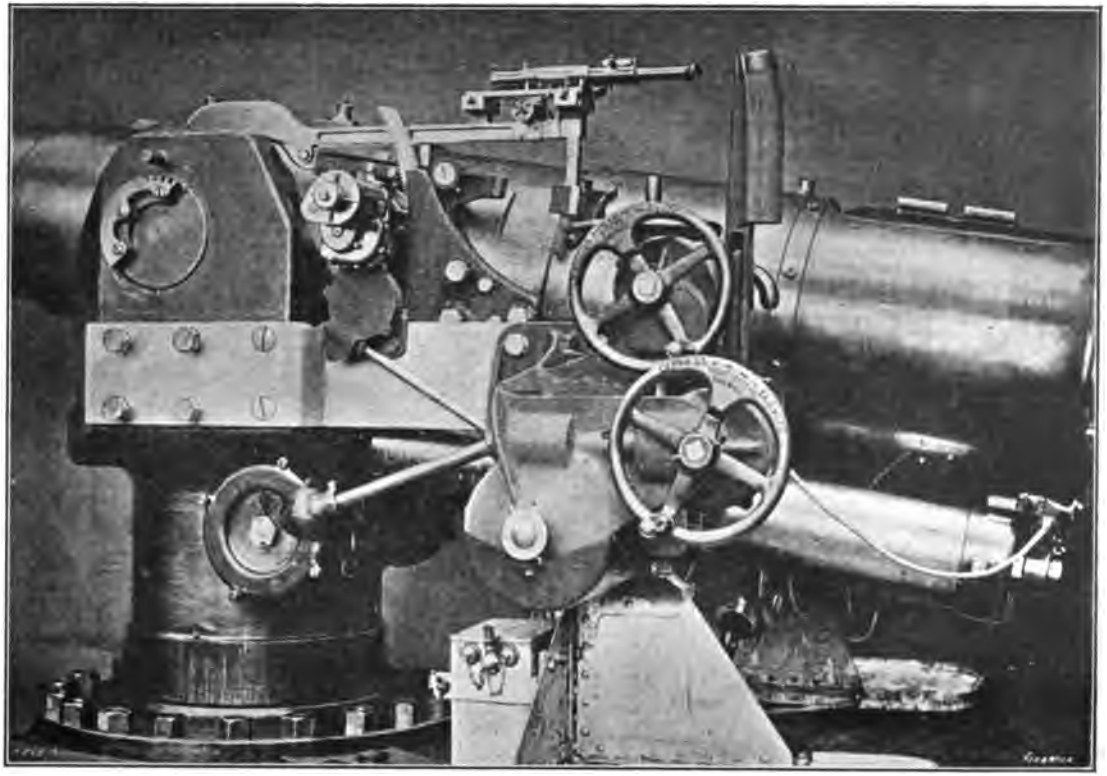


Fig. 1. Sighting Gear fitted to 6-inch Gun on H. M. S. "NARCISSUS".

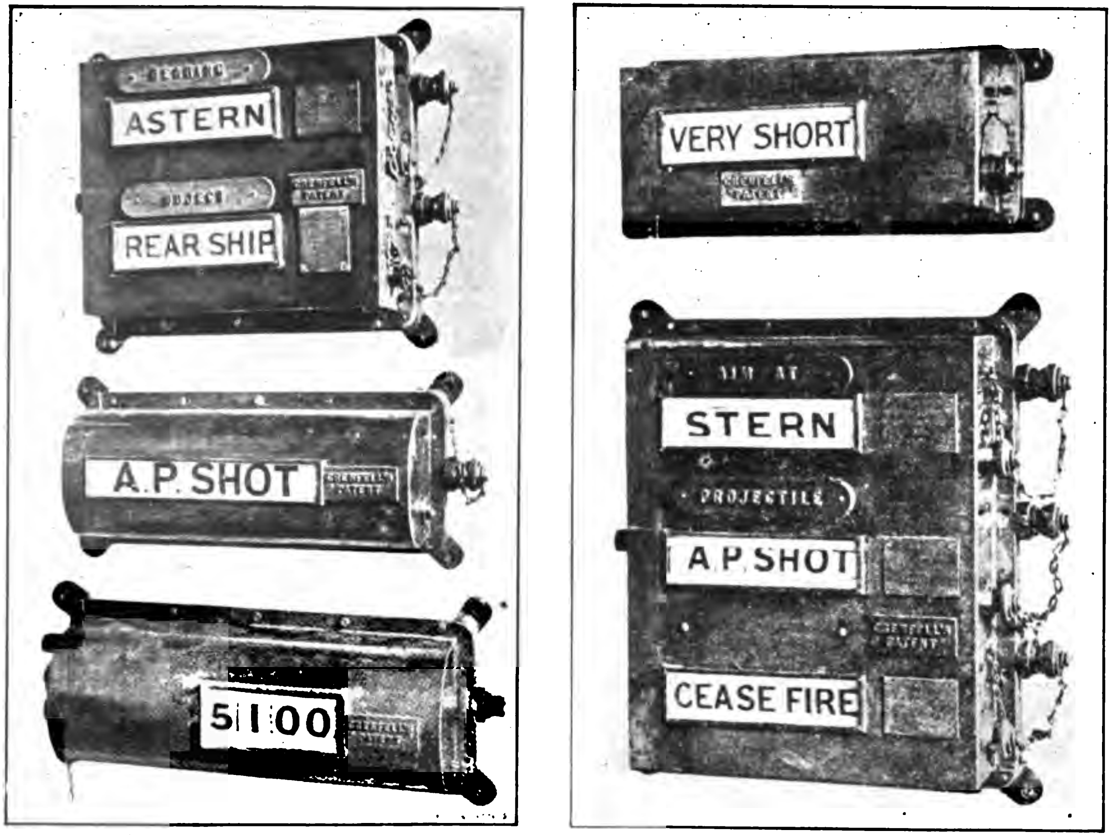


Fig. 2. Signalling Gear on H. M. S. "VENERABLE".

the interval between the rounds, require a carefully trained sight-setter whose whole attention is concentrarted upon these observations, and who must be given complete independence in the performance of this operation.

Thus it is evident that these two operations, of "aligning the sight and firing the gun," and "controlling the angle between the axis of the gun and the line of sight," are wholly dissimilar in their requirements. Each can only be performed in a perfect manner if it is rendered easy and rapid; and if it can receive the undivided attention of those executing it, free from all other considerations and outside disturbances.

It follows as a necessary consequence that the two operations cannot be performed by one operator; that the performance of one operation must in no way affect that of the other; and that both must go on independently and continuously.

The mechanism proposed for embodying these considerations is consequently designed to *effect the isolation of the two fundamental operations*, freeing one from the restrictions imposed by the requirements of the other, in order that each may be developed and perfected in accordance with its own peculiar requirements; while co-ordinating them to produce the utmost rapidity and accuracy of fire.

It does this as follows:

The firer is provided with a hand-wheel, with which he can freely control the alignment of the sight and gun together in elevation, but is unable to alter the angle between the axis of the gun and the line of sight.

The sight-setter is provided with a hand-wheel, so placed that he can command a clear view of the fall of shot and of the changing conditions, and by operating which he alters the axis of the gun in relation to the line of sight, or, in other words, he *adjusts the gun for range* without altering or disturbing the line of sight in any way.

The firer and sight-setter can work their hand-wheels simultaneously or independently, neither interfering with the result required by the other, or being conscious that the other operation is taking place.

Thus the gun can be maneuvered by the laying numbers without reference to the work of the sight-setter, and the sight-setter who is observing the target, etc., can adjust the axis of the gun for range with the maximum rapidity, and keep it adjusted right up to the instant of firing.

The application of the system as carried out in the *Narcissus* mounting provides for the movements of the gun and sights in elevation only. To completely carry out the system, the horizontal component of the laying operation —*i.e.*, the training, as well as the adjustment for deflection, should be similarly treated. This is quite practicable in hand-worked mountings, and the necessary mechanism for this has been designed.

The general arrangement is to place the hand-wheel for training the gun and sight together in pointing, in its present position, for the training number on the right of the gun. The hand-wheel for adjusting the gun in deflection is placed conveniently with that for effecting the adjustment in elevation.

As illustrating the effect which the application of this system has in admitting of the separate development and perfection of the *method* and *means* of carrying out the two fundamental operations, the following considerations are of interest:

1. In the *method* of controlling the angle between the axis of the gun and "line of sight," experience may show the desirability of employing two men —one to observe and correct errors in deflection, the other to observe and cor-

rect errors in elevation. For this purpose the proposed mechanism is peculiarly suitable, as the hand-wheels for effecting the two adjustments can be arranged one on either side of the gun, or in a variety of positions clear of the gun numbers.

2. Speed of sight adjustment, being of great importance, can be accelerated with proposed mechanism as much as desired; the rate depending merely upon mechanical advisability. This may be of great importance in rapidly changing from one target to another.

With the existing arrangements great speed of adjustment would be very confusing to the aim, and would be physically objectionable, as the eye-piece of the telescope has to be carried away from the eye of the firer.

Mention must now be made of some further effects arising out of the application of this system.

The sight-setter must necessarily assume his true function—that of *controlling the work of the firer to produce the desired result.* This can only be effected if he is given the absolute and independent control of the angle between sight and gun, in accordance with reasoned deductions from *his own* observations of the fall of shot, speed, bearing, etc. His duties are fully as important as those of the firer, and possibly more difficult to satisfactorily perform, and it would appear that he should therefore receive just as careful a training.

With such a training and the proposed mechanism, the sight-setter is raised to his full value.

So important is he, that it seems necessary when the system is applied to power-worked guns, that he should have an observation hood of his own, from which he can make his observations, and where he can control the sight adjustments. This application of my system to power-worked mountings has also been worked out.

With this system the sight-setter may be compared with one directing the water from a hose; the gun being the hose, the firer the power behind the water.

The transmission of clear signals to the gun, during an action, is of equal importance in the accurate fire, and Captain Grenfell's system may be regarded as a supplement to, and completion of, his firing device. Figure 2, illustrates this system, as installed on H.M.S. *Venerable.* The apparatus works electrically, and is designed to state the range, the kind of projectile to be used, the part of the hostile ship to be aimed at, and so forth. One order only is transmitted and displayed at a time, and it remains displayed and acted upon until it is cancelled by another order. The illustrations we give show clearly the working of the apparatus. As will be seen, it gives the captain the means of sending immediately to any part of his ship, the orders necessary to work all his fighting units with a maximum efficiency and in a minimum time. The transmitters in the conning-tower and the receivers at the various stations on the ship are identical, as regards the signals shown, though the transmitters in the conning-tower act mechanically only as regards the signals there shown, but electrically as regards those displayed at the gun positions, shell-rooms, passages, etc. When the captain gives an order to the guns and shell rooms on one circuit, he places the required signals so that they appear on his transmitter, when a ringing signal is given at each corresponding receiver, which displays also the order in the same way as it appears on the captain's transmitter. In this manner the captain not only acquires the power to control and direct the firing of each group of guns, but he can make a tactical use of his offensive power to a degree otherwise impossible. The fire of his ship is under his absolute personal control, and the gunners are continuously furnished with the precise and full information on which the successful effect of their fire depends. With Captain Grenfell's sighting device—the object of which is, as we have pointed out, to greatly increase the rapidity and accuracy of gun-firing—it may be objected that his signalling system will deprive the firer and sight-setter of initiative. It should be remembered, however, that it will be practically impossible for these men, to judge of the full effect of their individual fire, and to select the best means of utilizing to the utmost the power placed under their charge. The signalling apparatus forms, therefore, a necessary complement to the sighting device, and places absolute responsibility with the officer fighting the ship.

—*Engineering*, January 16; February 13, 1903.

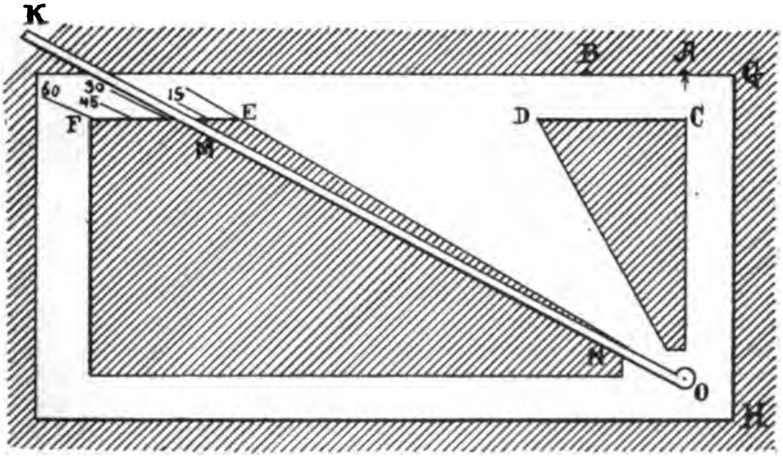
### Description of a Predicting and Set Forward Ruler.

DESIGNED BY CAPTAIN FRANK W. COE, ARTILLERY CORPS.

The ruler consists of a piece of wood or celluloid one-tenth of an inch in thickness, and, for a scale of 500 yards to the inch, about four inches by eight inches. The shaded part in the sketch below is cut away.

The sketch is made of a model designed for a two minute prediction and a set *forward* point. Therefore $C D = \frac{1}{2} D E = E F$.

To use the ruler suppose $A$ to be a plotted position of the target, $B$ a second position one minute later. Put the ruler in the position shown and draw a pencil line through $AB$. Slip the ruler along a straight edge laid in contact with $G H$ until the edge $O D$ covers $B$. The point were the edge $O E$ cuts the line through $A B$ will be the predicted point. The point where the pivoted arm ($O K$) cuts the line through $A B$ will be the set forward point for the number of seconds time of flight at which the arm is set on the scale on $E F$.



The time of flight can be determined with sufficient accuracy, after the second observation, (assuming 20 seconds interval) and the arm is set by an assistant before the plotter uses it. A clamp screw should be put on to hold the arm in position.

If deemed advisable, the edge *O E* could have substituted for it a pivoted arm, so that a prediction for any time could be made; but this would necessitate a sliding scale for the set forward or set back point, the origin always being where the arm corresponding to the line *O E* might cut the prolongation of *C D*.

The arm *O K* should be two-tenths of an inch thick, the part that lies *over* the ruler frame being cut away so as to allow the arm to rest on the paper from *M* to *N*. The edges *GB*, *DO*, *EO*, and the edge of the arm next to *EO* should be beveled.

### A Method for Determining the Predicted and Set Forward Point.

The following method is successfully used by the companies at Fort Monroe, Va., giving results readily, sufficiently accurately and in a minimum amount of time.

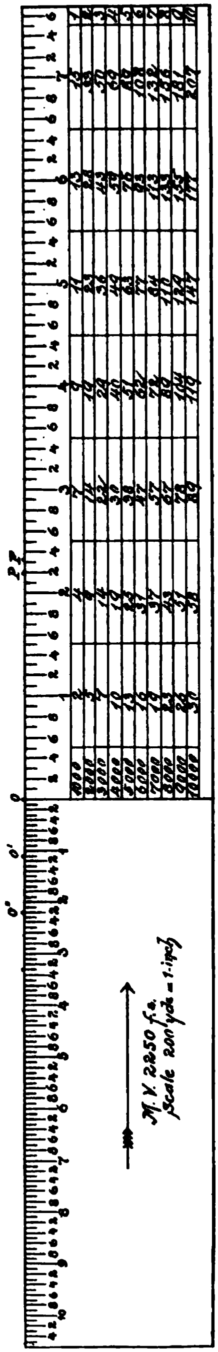
The scale used is illustrated in the figure. It consists of a piece of heavy mounted drawing paper about 13 inches long and 1¼ inches wide, the upper edge of which is graduated as shown. Card board, wood or celluloid would answer equally well, only it is easier to construct the scale on the drawing paper, and the latter answers all practical requirements.

The upper edge of the left hand side of the scale is graduated 200 yards to the inch, the smallest division being 10 yards, and numbered as shown in the figure. The divisions of the graduation of the upper edge of the right side of the scale are double the corresponding divisions on the left, the scale being constructed for a two minute prediction.

Under the predicting graduation is a table of figures for determining the set forward point. These figures show the number of yards travelled by the target during times of flight for ranges from 1,000 to 10,000 yards, and for speed of target corresponding to the distance travelled in the interval on which the prediction is made. The times of flight are taken from the range table and the corresponding distances computed and written in the table.

*To Use the Scale.*—*O''*, *O'*, and *O* are three plotted points, 30 second interval. The scale is placed as shown, *O* at the zero, and the predicted point, *P*, is at once set off on the right at the corresponding reading, 220. The range being 5,000 yards, for example, a glance at the column of figures under 2 on this side of the scale shows the travel during time of flight to be 25 yards, (actually 28 yards) which is at once set off by the plotter, and thus the set forward point determined at *F*, bearing in mind that these divisions are 20 yards.

If desired, more columns of figures, showing the travel for speeds between the even hundreds, could be added,



but interpolation is readily performed by one used to working with the scale, and close interpolation is not necessary.

Similarly, corresponding figures for ranges of 1,500, 2,500, 3,500, etc., could be readily added by making the scale wider. But differences of times of flights for ranges differing by less than 1,000 yards are small, and they may be neglected without great error.

A similar scale is constructed and used for targets moving in the opposite direction.

# DRILL REGULATIONS, MANEUVERS AND PRACTICE.

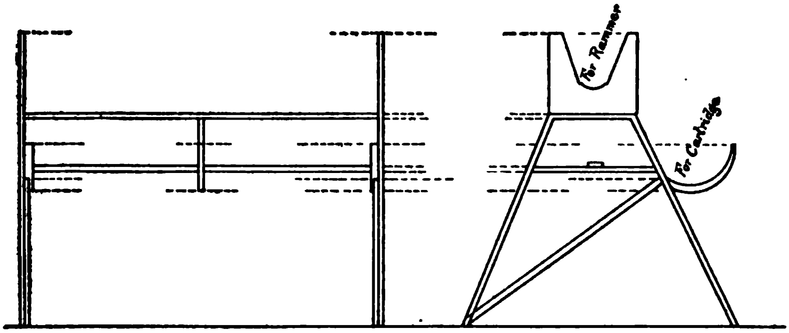
## Drill for the 5-inch R. F. Gun Model 1897.

By Second Lieutenant LEWIS S. RYAN, Artillery Corps.

This drill for the 5-inch R.F. gun 1897 has been tried for two months at San Diego, California, and so far has been found satisfactory.

The object of the preparation of the drill has been the most rapid service of the piece possible. By using a projectile and service charge the piece has been loaded repeatedly in nine and a half seconds. By going through the motions of loading and firing the piece has been loaded and fired eight times in fifty-eight seconds.

It was found necessary to use a prop for the rammer and cartridge, so one similar to the sketch below was made.



A rammer that had no shoulder back of the head was devised so that there would be no danger of bringing the loading tray with the rammer on withdrawing the rammer.

A priming wire about three inches long and with an awl handle was made so that the vent could be cleared while the piece was being loaded.

### GENERAL INSTRUCTIONS FOR DRILL AND PRACTICE.

*Drill.*—It is essential to the successful service of rapid fire guns that they should be served as rapidly as possible. To attain this end alertness of attitude, smartness of movement and silence must be enforced during the drill.

The gun commander will watch the movement of each man and correct any clumsy or unnecessary movements. He shall see that no part of the manual is slighted but shall see that the quickest method of executing it is employed and careful attention must be given to the details.

At the command " Take cover," given at any time during the drill, all the cannoneers lay down their equipment or implements and take cover at double time.

At the command "Stand fast" the cannoneers will halt in place and remain so until the command "Go on" is given.

When a cannoneer makes a mistake the command "Stand fast" shall be given and he shall be corrected. If it can be avoided the command "As you were" will not be given to the entire detachment but only to the number or numbers concerned.

Provision should be made for casualties by naming the successors for the gun commander and the gunner.

*Practice.*—The gun and its equipment should be examined to see that they are in good order.

The elevating and traversing gear tested to see that there is no back lash and that they work smoothly. The racking up gear is tested to see that the levers work both ways and that the carriage is raised and lowered off with the same ease, also that the clamp is in working order. The recoil cylinder is examined to see that it is properly filled and that the plugs are set. To fill the recoil cylinder depress the piece as much as possible and pour in neutral oil until the cylinder is entirely filled and set the plug. Care should be taken to see that no air cushions are formed.

*Time fuses.*—Fuses from three to four years old burn slower and should be bored 10 per cent shorter than when new. The age of fuses should be noted and those of one date selected for practice, or at least for the same series.

*Loading.*—Before giving the command "Load," the battery officer will prescribe the projectile and the kind and length of fuse. In the detail the term load means the service of the cartridge and projectile. Attending the vent means removing the old primer and clearing the vent. The old primer is removed as the breech block is about to be withdrawn, see Manual.

When necessary to use the punch, priming wire, or reamer to clean the vent they will be introduced from the mushroom-head end of the vent. In all cases care will be taken to avoid scoring the vent and the primer seat.

Ready, means that the lanyard is attached or if firing by electricity that the breech has been closed preparatory to firing.

When carrying on practice and it should be necessary to leave the gun loaded with a filled and fuzed shell, the cartridge will be withdrawn and the shell left in the gun until a favorable opportunity for firing the round is offered. *On no account will an attempt be made to drive the shell out of the gun.* Before leaving the gun the breech will be secured and any necessary precautions taken until the round is fired. If the projectile is not fuzed the cartridge is withdrawn and the projectile driven back and withdrawn through the breech.

*Missfires.*—(a) If firing by friction primer the cartridge should be removed and placed out of the way. The breech will not be opened until a sufficient delay has been made to guard against a hang-fire and then it should be carefully opened.

(b) If firing by electricity in case the primer fails to fire when the contact is made the alternating cable will be attached and the contact again made or the primer may be fired by the lanyard.

*Cease firing.*—At the command "Cease firing" the lanyard will be removed if attached or if firing by electricity the breech will be opened.

### GENERAL DUTIES OF THE GUN COMMANDER AND THE GUNNER.

The gun commander commands the gun and is responsible to the battery commander for its regular and efficient service in all respects.

The gun is fired only in accordance with his commands for firing. At practice, he is responsible that the gunner identifies the target ordered, and for the first shot of series knows the elevation and deflection. When time fuzes are used he bores or sets them.

In exceptional cases the gun commander may have to perform the duties of the battery officer.

The gunner's special duties are aiming and firing the gun. He will aim on the part of the target ordered by the battery officer.

### AIMING AND FIRING.

*Case I.*—Direction and elevation given by the sight.

The gun commander announces the part of the target to be fired at and gives the elevation and deflection for each shot of a series. The gunner will then follow the target by judgment until another series of shots are fired. If the gun is to be elevated more than 4½ degrees it will be necessary to raise the shield. To do so the gunner commands "1. Man shield. 2. Raise." At the first command No. 1 places himself on the steps by the gun and with the left hand grasps lever and with the right removes the locking pin. No. 2 places himself on the left of the gun so that he can place his weight on the highest part of the shield. At the second command No. 1 throws his weight on the lever and No. 2 his weight on the shield. No. 1 inserts locking pin when the shield is in position.

To lower the shield the gunner commands "1 Man shield. 2 Lower." At the first command No. 1 places himself on the gun steps and grasps the lever in his left hand and the locking pin in his right. No. 2 places himself on the left of the piece preparatory to putting his weight on the shield. At the second command No. 1 puts his weight on the lever at the same time removing the pin and allows the shield to lower and replaces the pin. No. 2 places his weight on the shield until No. 1 has removed the pin and then he assists in keeping the shield from falling too heavily.

The gun commander indicates the kind of fire to be used by the following commands:

To fire each round by order of the gun commander he orders:—1. *Fire by round.* 2. *No.*—. 3. *Load.* 4. *Fire.*

To fire continuously, the gun commander orders:—1. *Continuous fire.* 2. *Commence firing.* At the first command the piece will be loaded and at the second command the piece will be fired and loading and firing continued until the manner of firing is changed. The piece will be fired as rapidly as is consistent with aiming. Whether firing by electricity or friction No. 2 draws the lanyard taut as soon as the breech is closed. If firing by electricity and the primer does not explode the gunner commands "Fire", whereupon No. 2 fires. Firing will be by electricity unless it fails to work. In practice loadings without actual firing the gunner will command "Load" as soon as each shot is supposed to have been fired.

*Case II.*—Direction is given by sight and elevation by quadrant. This case will be used only when the sight has been disabled when the direction will be obtained by sighting along the gun.

## MANUAL FOR FIVE-INCH RAPID FIRE GUN MODEL, 1897.

### GUN DETACHMENT.—GUN COMMANDER, GUNNER AND 4 CANNONEERS.

| *Name of Detail.* | *Duties and Posts.* |
|---|---|
| *Gun Commander* (Sergeant) | Carries up range scale and difference chart and places them in a convenient place, sees that the batteries are put in the proper brackets and that the electrical connections are properly made.<br>*Post.*—Two yards in rear of the loading platform facing the gun. |
| *Gunner* (Corporal or private, duly qualified). | Carries up sight (front and rear) and pistol and places them in position and makes all electrical connections on the gun. For night drill he brings night sights and places them in position. Gunner fires.<br>*Post.*—On loading platform to the left of and alongside of the shield. |
| *Breech Detail* (2 privates, Nos. 1 and 2). | Nos. 1 and 2 assist each other in putting on the sleeves. No. 1 puts on primer pouch containing primer wire and primers, carries up two water buckets containing water and hand sponge and places them on the loading platform under the breech. He also opens and close breech, ejects old primer, and cleans vent, (if necessary) cleans breech block, and inserts new primer. No. 2 carries up loading tray, rammer and its support and lanyard, placing lanyard in center of loading platform, support to right of breech on platform to avoid recoil, and rammer on support and tray convenient to breech. He also inserts and removes loading tray, launches and rams projectile, inserts cartridge and sees that it is sent home. He hooks lanyard on for first shot leaving it on for succeeding shots. No. 2 fires if electrical connections fail. Nos. 1 and 2 remove and replace breech cover, raise and lower shield and assist in sponging.<br>*Posts.*—On rear of loading platform facing the breech. No. 1 on the right, No. 2 on the left. |
| *Charge Detail* (2 privates, Nos. 3 and 4). | Nos. 3 and 4 remove and replace muzzle cover. No. 3 carries up oil measure, filling funnel, plug wrench and ratchet bar, placing bar on right pinion shaft and oil measure, filling funnel and plug wrench convenient to the cylinder, examines and if necessary fills recoil cylinder. He carries cartridge from head of stairs and places it on shelf of rammer support. He also assists in sponging. No. 4 carries up ratchet bar, box of electrical cables, placing bar on left pinion shaft and cable box in its proper bracket, receives breech cover from No. 2 and muzzle cover from No. 3 and, if called for, passes up oil measure and funnel to No. 3. He brings projectile from niche passing it to |

No. 2 and brings up and replaces sponge and assists in sponging.

*Posts.*—No. 3 at head of stairs facing gun. No. 4 one yard in front of niche facing gun.

| *Ammunition Detail.* | *Ammunition Sergeant and* 2 *Privates.* |
|---|---|
| ***Ammunition Sergeant.*** | Inspects magazines, fuzes shells when required, and exercises a general supervision over supply of ammunition. |
| ***Cartridge Detail*** (1 private). | No. 1 carries up stave and its prop, placing prop 4 yards in rear of cylinder and stave on prop. For night drill he carries up E. L. battery and places it in the proper bracket. He throws cartridge from foot of stairs to No. 3. |
| ***Magazine Detail*** (1 private). | No. 2 carries up the two firing batteries and places them in their proper brackets. He assists ammunition sergeant in fuzing shells when required. At other times uncases cartridges and places empty cases to one side. He passes cartridges to No. 1 cartridge detail. |

*Posts.*—No. 1 at foot of stairs facing ammunition room. No. 2 in ammuntion room as directed by ammunition sergeant.

At the command "Stores and Posts" ranks are broken and each cannoneer brings up his stores and puts them in their proper places. The electrical connections are made while the piece is racked down. The piece is racked up with the gunner and breech detail off of the platform and after the piece is racked up they take their posts.

At the command "Examine gun", the breech and muzzle covers are removed, folded and placed out of the way. The breech is opened and vent cleared, the bore, chamber, breech-box, breech-block and breech mechanism carefully inspected, and the parts needing it thoroughly cleaned and the breech closed after inspection, the electrical connections tested. The recoil cylinder opened, examined, filled if neccessary and the plug securely set. the elevating and traversing gear tested, the sights tested and the communications tested.

At the command "Load" the old primer is ejected. the breech opened and vent cleared, breech-block cleaned and oiled if necessary and new primer inserted. Meanwhile the loading tray has been inserted, projectile passed to No. 2 who inserts and rams it, cartridge placed on shelf, cartridge inserted and pushed home by hand until it barely clears gas check seat, loading tray removed, breech closed, hook of primer inserted in eye of slide for the first shot and left inserted thereafter until the command "Cease firing". Meanwhile the gun has been aimed during loading.

If necessary to clean the bore and chamber No. 4 brings up the sponge with the stave attached, when it has been called for by No. 1. The piece is then elevated so that Nos. 1 and 2 from the platform and Nos. 3 and 4 from below can sponge the bore. The stave is then detached by No. 1 and replaced by No. 4. Nos. 1 and 2 then sponge the chamber and No. 4 replaces the sponge.

For commands for firing see "General Duties". The firing of the gun is done by the gunner or by No. 2 if the electrical current fails to explode the primer.

To raise the piece to the firing position the gun commander commands "1. Man rachet levers. 2. Unlock. 3. Rack up. 4 Halt. 5. Clamp." At the first command Nos. 3 and 4 go to the right and left ratchet levers. At the second command No. 4 unclamps pinion and at the third command both numbers working together with a steady pull rack up the piece. At the command "Halt" which is given when the piece is in firing position, both numbers reverse their levers preparatory to racking down. At the last command No. 4 clamps the pinion.

To lower the gun from the firing position the gun commander commands "1. Man ratchet levers. 2. Unclamp. 3. Rack down. 4. Halt. 5. Clamp." At the first command Nos. 3 und 4 go to the right and left ratchet levers and at the second command No. 4 unclamps the pinion. At the third command both numbers rack the piece down working with an even steady pull. At the command "Halt" given when the piece is down both numbers reverse their levers preparatory to racking up. At the fifth command No. 4 clamps the pinion. The platform should be clear of men when the piece is racked up. The cannoneers resume their posts after each racking up or down of the piece.

### NOTES ON THE MANUAL.

The posts of the gun detachment as given above are for inspection and preparatory to the service of the gun.

The gun commander goes wherever his presence is necessary.

The reserve is posted for inspection in two ranks on line with rear wall of the parapet. At drills they will remain under cover wherever the gun commander directs.

The posts of a cannoneer when once assigned in the "Manning Table" will not be changed except for good reason. In order that the men may become proficient in their duties they should be assigned for the week or bi-weekly.

The posts of absentees from the gun detachment will be supplied from the reserve when there is one and not from the ammunition detail unless it becomes necessary to drill with diminished numbers.

When the gun detachment breaks ranks at the command "Stores and Posts" the gun commander sees that the several numbers take the proper stores from the store room and place them as directed.

*Duties of the Gunner.*—The gunner places the sights on the carriage and tests them by elevating and depressing and working the deflection screw, seeing that there is no back lash in them. If the night sights are used he places the white light at the front sight and the red light on the rear sight, the resistance pointer being set at "Off." To use the night sight the pointer should be turned in the direction of the arrow so as to give the smallest quantity of light compatible with distinguishing the sight. During a pause in firing the pointer should be turned to "Off." At "Cease firing" the cables and plug connections are to be removed. As the lights grow dimmer turn the pointer further in the direction of the arrow. The firing batteries are placed in the brackets next to the shield, hinges out, and the battery on the left is ordinarily used for firing.

The circuit is made by joining the binding post next to the shield with the battery by the short cable that has an eye in each end, the other binding post of the battery is connected to the front nipple of the pistol by the four foot cable. The rear nipple of the pistol is connected to the lower contact plug by the five foot five inch cable the center of which rests on the twisted hook under the recoil cylinder. The firing cable connects the upper contact plug to the circuit breaker on the breech-block and is supported by the cable supports.

To test the connections before firing a shot press the button on the pistol, for an instant only, placing the ear near the pistol, if the circuit is made the buzzer can be heard.

*Duties of Breech Detail.*—No. 1 ejects the old primer as he opens the breech (by placing the right fore arm on breech of gun grasping the slide in the right hand pulling up on the handle as he opens the breech with the left hand), clears the vent, by reaching left hand over the breech-block, if necessary, cleans breech-block (by reaching over block), inserts new primer and closes breech-block. No. 2 inserts loading tray, receives projectile from No. 4, inserts it and taking rammer from support, rams the projectile with force, removing rammer smartly, placing it on support, takes cartridge from support and inserts it so that it just clears the gas-check seat, removes loading tray which he holds preparatory to the next loading. He hooks lanyard in eye of slide for the first shot leaving it inserted thereafter, and immediately cautions "Ready." If the electrical current does not fire the primer the gunner commands "Fire" whereupon No. 2 fires by the lanyard.

No. 3 at the command "Load" carries cartridge from the head of the stairs, placing it on the shelf of the rammer support and immediately returns for another cartridge bringing it up as the next loading begins.

At the command "Examine gun" No. 3 takes plug wrench and mounts on the steps, unscrews and takes out filling plug to ascertain if the recoil cylinder contains the proper amount of oil and if necessary to fill he calls for the funnel and oil measure and fills cylinder, replacing plug screwing it well home.

At the command "Load" No. 4 carries projectile from niche passing it up to No. 2 and immediately returns to the niche for another projectile which he has convenient to the breech for the next loading. If No. 3 calls for the funnel and oil measure he passes them up.

No. 1 magazine detail has cartridge ready to throw to No. 3 charge detail as fast as he is ready to receive them.

### MANUAL FOR FIVE-INCH RAPID FIRE GUN MODEL, 1897.

(Mounted on carriages numbered above 33.)

The manual is the same as for the other carriages with the following exceptions and modifications.

| *Name of Detail.* | *Duties and Posts.* |
|---|---|
| *Gunner.* | Carries up sights (front and rear peep) and telescopic sight and puts them in place. |

## Attacks on Coast Fortifications in the French Fleet Maneuvers, 1902.

TRANSLATED BY MAJOR JOHN P. WISSER, ARTILLERY CORPS.

Including the bombardment of Algiers by the Mediterranean squadron, which took place before the maneuvers proper, three attacks on coast forts took place.

In the bombardment of Algiers on July 5th, one division of ships-of-the-line took the works on the east side under fire, and another those of the west side, the firing taking place at long ranges, varying from 6500 to 9800 yards, at which the ships (owing to the natural dispersion of the shots from the forts at these ranges, and the difficulty of observation from the shore) were comparatively safe, but the effect of their own shots was also very doubtful, to say the least. It was assumed that the works were silenced in the forenoon, and in the afternoon the town was bombarded. In this exercise the main object was to determine the amount of ammunition required, and it was concluded, as has been previously often decided, that ships cannot undertake the bombardment of coast works unless the supply of ammunition can be assured, and that expended can be replaced with certainty.

The attack on Bizerta, on July 21st and 22d, was designed as a test of the recently completed fortifications, which were fully manned. The defense also had at its disposal the armored coast defense vessel *Tempête*, the armored gunboat *Phlégéton* and the torpedo boats of the mobile defense, The two armored vessels lay in the entrance to protect the channel, the torpedo boats were sent out on the evening of the 21st to reconnoitre out to sea.

Vice-Admiral Gervais, who approached Bizerta from the north with his fleet on the evening of July 21st, kept the battleships at sea at a great distance from the coast, and between the latter and his battleships he placed the armored cruisers. A light division was sent out as a protection against torpedo boat attacks as far as the Island of Galita, and a number of torpedo boats were advanced toward the harbor entrance to reconnoitre and determine the character of the defense, and to fire on any batteries covering the obstructions as well as on any search-lights that may be located on shore.

Towards daybreak the main body of the fleet moved on Bizerta. It was divided into three groups, moving in a north-westerly direction, the left wing resting on the southern portion of the coast. There stood the battleships, divided into four divisions, the whole under the Fleet Commander, and began the bombardment of the works at 6 a.m. Each division went separately up to within 6500 to 5400 yards from the works, moved past the latter and returned, while the next division followed at 2100 yards distance behind the first, and so on. The armored cruisers supported the attack at long range, and to their right the protected cruisers, also at long range, fired on the North Fort by way of reconnaissance preparatory to its subsequent attack by the battleships.

In the center the torpedo boat destroyers guarded the harbor entrance, to ward off torpedo boat attacks from the fleet; they were driven away by the *Phlégéton*, which weighed anchor and pursued them.

At 9 a.m. the exercise was ended, and it is reported that it proved that this important point of support is sufficiently protected and secured against any sudden attack.

The bombardment of the works on the Island of Porquerolles, on August 1, was more in the nature of an exercise for the garrisons of the works than of a tactical measure. It was prepared for by the armored cruisers at long range, after which the battleships approached closer to the works and fired in passing.

Vice-Admiral Gervais' method before Bizerta, of sending constantly against the works new, or at least rested ships, keeping the garrisons at work uninterruptedly, without rest or breathing time, while his own crews can rest at intervals, is a new idea.*

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* And one that indicates the necessity of having *three* reliefs at the guns.—TRANSLATOR.

—*Marine Rundschau*, October, 1902.

# ORGANIZATION AND ADMINISTRATION.

## List of Gunners, (1st and 2d Class), Artillery Corps, U. S. Army.

The following list of gunners who qualified in the various organizations of the Artillery Corps at the examination held about a year ago, has been compiled in the office of the Chief of Artillery from the files of special orders of the several Departments.

FIELD ARTILLERY BATTERIES.

| Battery. | Date of Report of Examination. | Class 1st | Class 2nd | Remarks. |
|---|---|---|---|---|
| 1st | | | | Presidio, S.F. |
| 2nd | July 24, 1902. | 12 | 13 | Fort Sam Houston, Tex. |
| 3rd | | | | Chickamauga Park. |
| 4th | March 4, 1902. | | 5 | Fort Myer, Va. |
| 5th | | | | Presidio, S.F. |
| 6th | May 8, 1902. | 5 | 16 | Fort Riley, Kan. |
| 7th | May 13, 1902. | 17 | 16 | Fort Riley, Kan. |
| 8th | | | | Fort Sheridan Ill. |
| 9th | February 25, 1902. | 1 | 8 | Fort Sheridan, Ill. |
| | November 6, 1902. | | 13 | |
| 10th | October 13, 1902. | 9 | 15 | Fort Walla Walla. |
| 11th | March 11, 1902. | 14 | 3 | Fort Hamilton, N.Y. |
| 12th | | | | Fort Douglas, Utah. |
| 13th | | | | Fort D. A. Russell. |
| 14th | | | | Manila, P.I. |
| 15th | | | | Manila, P.I. |
| 16th | April 25, 1902. | 1 | 6 | Fort Leavenworth. |
| 17th | July 24, 1902. | 4 | 10 | Fort Sam Houston, Tex. |
| 18th | | | | Presidio, S.F. |
| 19th | May 20, 1902. | 2 | 18 | Fort Riley, Kan. |
| 20th | May 22, 1902. | 7 | 11 | Fort Riley, Kan. |
| 21st | February 25, 1902. | | 7 | Fort Sheridan, Ill. |
| | November 6, 1902. | 2 | 20 | |
| 22nd | | | | Fort Douglas, Utah, |
| 23rd | March 15, 1902. | 2 | 6 | Fort Ethan Allen. |
| 24th | | | | Presidio, S.F. |
| 25th | | | | Manila, P.I. |
| 26th | | | | Vancouver Barracks. |
| 27th | March 15, 1902. | 3 | 6 | Fort Ethan Allen. |
| 28th | | | | Fort Leavenworth. |
| 29th | | | | Fort Sill, Oklahoma. |
| 30th | October 13, 1902. | 7 | 27 | Fort Walla Walla. |

COAST ARTILLERY COMPANIES.

| Company. | Date of Report of Examination. | Class 1st | Class 2nd | Remarks. |
|---|---|---|---|---|
| 1st | November 25. 1901. | 3 | 13 | Fort Dade, Fla. |
| 2nd | November 22, 1901. | 4 | 6 | Fort Trumbull, Conn. |
| 3rd | November 25, 1901. | 3 | 2 | Sullivans Island. |
| 4th | December 14, 1901. | 3 | 16 | Fort St. Phillip. |
| 5th | February 24, 1902. | 12 | 18 | Fort Screven, Ga. |
| 6th | November 19, 1901. | 22 | 5 | Fort Monroe, Va. |
| 7th | December 4, 1901. | 9 | 10 | Fort Pickens, Fla. |
| 8th | December 10, 1901. | | 5 | Fort Morgan, Ala. |
| 9th | December 5, 1901. | 1 | 8 | Fort Pickens, Fla. |

| Company. | Date of Report of Examination. | Class 1st | Class 2nd | Remarks. |
|---|---|---|---|---|
| 10th | December 3, 1901. | 10 | 16 | Sullivans Island. |
| 11th | November 19, 1901. | 10 | 5 | Fort Taylor, Fla. |
| 12th | | | | Fort Clark, Tex. |
| 13th | November 25, 1901. | 47 | 9 | Fort Monroe, Va. |
| 14th | February 26, 1902. | 8 | 18 | Fort Screven, Ga. |
| 15th | December 6, 1901. | 11 | 11 | Fort Pickens, Fla. |
| 16th | March 4, 1902. | 2 | 13 | Fort Fremont, S.C. |
| 17th | | | | Cuba. |
| 18th | | | | " |
| 19th | | | | " |
| 20th | | | | " |
| 21st | | | | " |
| 22nd | | | | " |
| 23rd | | | | " |
| 24th | | | | " |
| 25th | | | | " |
| 26th | February 10, 1902. | 7 | 7 | Fort Flagler, Wash. |
| 27th | | | | Manila. |
| 28th | December 26, 1901. | 18 | 9 | Presidio, S.F. |
| 29th | December 26, 1901. | 7 | 7 | Presidio, S.F. |
| 30th | January 14, 1902. | 4 | 10 | Fort Rosecrans. |
| 31st | | | | Manila. |
| 32nd | | | | Alaska. |
| 33rd | January 29, 1902. | | 2 | Fort Canby, Wash. |
| 34th | January 27, 1902. | 14 | 5 | Fort Stevens, Oreg. |
| 35th | March 20, 1902. | 4 | | Fort Monroe, Va. |
| 35th | December 5, 1901. | 37 | 9 | Fort Monroe, Va. |
| 36th | | | | Manila. |
| 37th | November 25, 1901. | 16 | 5 | Fort Washington, Md. |
| 38th | November 20, 1901. | 10 | 8 | Fort Caswell, N.C. |
| 39th | November 16, 1901. | 22 | 7 | Fort Carroll, Md. |
| 40th | November 19, 1901. | 14 | 8 | Fort Howard, Md. |
| 41st | December 1, 1901. | 27 | 7 | Fort Monroe, Va. |
| 42nd | November 8, 1901. | 8 | 5 | Fort Mott, N.J. |
| 43rd | December 2, 1901. | 7 | 6 | Fort Terry, N.Y. |
| 44th | November 20, 1901. | 11 | 10 | Fort Washington, Md. |
| 45th | November 12, 1901. | 9 | 3 | Fort Delaware, Del. |
| 46th | November 15, 1901. | 4 | 3 | Fort Strong, Mass. |
| 47th | November 26, 1901. | 9 | 2 | Fort Hunt, Va. |
| 48th | December 14, 1901. | 11 | 9 | Fort Hancock, N.J. |
| 49th | | | | Fort Columbus, N.Y. |
| 50th | November 27, 1901. | 3 | 3 | Fort Wadsworth, N.Y. |
| 51st | November 22, 1901. | 5 | 7 | Fort Hamilton, N.Y. |
| 52nd | December 19, 1901. | 1 | 1 | Fort Columbus, N.Y. |
| 53rd | December 6, 1901. | 10 | 8 | Fort Wadsworth, N.Y. |
| 54th | December 9, 1901. | | 13 | Fort Totten, N.Y. |
| 55th | December 16, 1901. | 9 | 3 | Fort Hancock, N.J. |
| 56th | December 24, 1901. | 22 | 6 | San Juan, P.R. |
| 57th | December 5, 1901. | 13 | 11 | Fort Wadsworth, N.Y. |
| 58th | December 14, 1901. | 38 | 5 | Fort Monroe, Va. |
| 59th | December 24, 1901. | 21 | 16 | San Juan, P.R. |
| 60th | | | | Presidio, S.F. |
| 61st | | | | Fort Baker, Cal. |
| 62nd | | | | Fort Worden, Wash. |
| 63rd | | | | Fort Casey, Wash. |
| 64th | | | | Fort Miley, Cal. |
| 65th | | | | Fort McDowell, Cal. |
| 66th | | | | Honolulu, H.I. |
| 67th | | | | Honolulu, H.I. |
| 68th | | | | Fort Baker, Cal. |

| Company. | Date of Report of Examination. | Class 1st | Class 2nd | Remarks. |
|---|---|---|---|---|
| 69th | December 10, 1901. | 24 | 5 | Fort Monroe, Va., |
| 70th | | | | Presidio, S.F. |
| 71st | | | | Fort Casey, Wash. |
| 72nd | November 19, 1901. | 4 | 7 | Fort Greble, R.I. |
| 73rd | March 18, 1902. | 21 | 10 | Fort Monroe, Va. |
| 74th | December 20, 1902. | 25 | 15 | Fort Williams, Me. |
| 75th | December 9, 1901. | 10 | 7 | Fort Preble, Me. |
| 76th | November 13, 1901. | 3 | 2 | Fort Banks, Mass. |
| 77th | November 25, 1901. | 11 | 13 | Fort Warren, Mass. |
| 78th | November 16, 1901. | 9 | 9 | Fort Adams, R.I. |
| 79th | November 16, 1901. | 6 | 5 | Fort Adams, R.I. |
| 80th | November 22, 1901. | 2 | 8 | Fort Schuyler, N.Y. |
| 81st | November 18, 1901. | 2 | 16 | Fort Slocum, N Y. |
| 82nd | December 19, 1901. | | 11 | Fort Totten, N.Y. |
| 83rd | December 19, 1901. | | 3 | Fort Columbus, N.Y. |
| 84th | November 14, 1901. | 10 | 6 | Fort Hamilton, N.Y. |
| 85th | December 2, 1901. | 8 | 5 | Fort Wadsworth, N.Y. |
| 86th | December 9, 1901. | 14 | 6 | Fort Wadsworth, N.Y. |
| 87th | December 6, 1901. | 1 | 14 | Fort Totten, N.Y. |
| 88th | November 23, 1901. | 6 | 11 | Fort Trumbull, Conn. |
| 89th | November 13, 1901. | 3 | 3 | Fort Banks, Mass. |
| 90th | November 15, 1901. | 14 | 7 | Fort Armistead, Md. |
| 91st | December 14, 1901. | 1 | 10 | Fort St. Philip, La. |
| 92nd | December 26, 1901. | 5 | 9 | Presidio, S.F. |
| 93rd | January 28, 1902. | 9 | 14 | Fort Stevens, Oreg. |
| 94th | February 10, 1902. | 5 | 9 | Fort Flagler, Wash. |
| 95th | December 16, 1901. | 25 | 5 | Fort Hancock, N.J. |
| 96th | November 29, 1901. | 23 | 6 | Fort Warren, Mass. |
| 97th | November 16, 1901. | 12 | 11 | Fort Adams, R.I. |
| 98th | November 18, 1901. | 3 | 9 | Fort Hamilton, N.Y. |
| 99th | December 10, 1901. | 2 | 2 | Fort Morgan, Ala. |
| 100th | December 2, 1901. | 2 | 4 | Fort Terry, N.Y. |
| 101st | December 11, 1901. | 1 | 5 | Fort Totten, N.Y. |
| 102nd | November 18, 1901. | 9 | 11 | Fort Caswell, N.C. |
| 103rd | November 18, 1901. | 5 | 8 | Fort Howard, Md. |
| 104th | November 22, 1901. | 9 | 8 | Fort Washington, Md. |
| 105th | December 26, 1901. | 3 | 3 | Presidio, S.F. |
| 106th | | | | Fort Flagler, Wash, |
| 107th | December 11, 1901. | 11 | 3 | Fort Preble, Me. |
| 108th | December 20, 1901. | 14 | 5 | Fort Williams, Me. |
| 109th | November 19, 1901. | 6 | 4 | Fort Greble, R.I. |
| 110th | November 16, 1901. | 7 | 14 | Fort Greble, R.I. |
| 111th | November 26, 1901. | 4 | 7 | Fort Dade, Fla. |
| 112th | November 13, 1901. | 6 | 2 | Fort Dupont, Del |
| 113th | | | | Fort McHenry, Md. |
| 114th | December 5, 1901. | 3 | 5 | Fort Totten, N.Y. |
| 115th | January 14, 1902. | 2 | 5 | Fort Rosecrans. |
| 116th | March 1, 1902. | 9 | 16 | Fort Screven, Ga. |
| 117th | November 26, 1901. | 1 | 2 | Sullivans Island. |
| 118th | November 4, 1901. | 15 | 3 | Fort Monroe, Va. |
| 119th | November 9, 1901. | 11 | 3 | Fort Mott, N. J. |
| 120th | November 16, 1901. | 7 | 2 | Fort Strong, Mass. |
| 121st | November 20, 1901. | 2 | 9 | Fort Taylor, Fla. |
| 122nd | | | | Fort Columbus, N.Y. |
| 123rd | November 25, 1901. | 6 | 10 | Fort Hamilton, N.Y. |
| 124th | December 4, 1901. | 5 | 3 | Fort Constitution. |
| 125th | | | | Fort Trumbull, Conn. |
| 126th | January 29, 1902. | | 1 | Fort Canby, Wash. |

An examination of the foregoing list shows that the 13th Company, Coast Artillery, had the largest number of gunners (1st and 2nd class). As the system of instruction by which such a successful result was obtained in this company, might be of considerable interest to the artillery, the following letter of the Commanding Officer, 13th Company, Coast Artillery, is published by permission of the Commanding Officer, Fort Monroe, Virginia.

Fort Monroe, Virginia, January, 1903.

To the Adjutant,
Fort Monroe, Virginia,
Sir:

In compliance with verbal instructions received from the Commanding Officer, I respectfully submit the following outline of the system of instruction pursued in the 13th Company, Coast Artillery, during the past three years:

When I assumed command of the 13th Company, (then Battery B, 2nd U. S. Artillery), there was but one qualified gunner in the organization, viz: First Sergeant E. R. Neville. I immediately organized a system of instruction as follows:

The company was carefully examined in order to classify the men into:

1st. Those capable of full instruction;
2nd. Those capable of partial instruction;
3rd. Those incapable of any instruction.

Instruction of the first section was conducted personally by the Captain; that of the second section by a Lieutenant when one was available, but generally by the First Sergeant. The third section comprised those men whose total lack of previous education precluded the possibility of their acquiring the knowledge necessary to become gunners. This section was detailed at the guns for cleaning, painting guns and carriages, cutting grass and generally policing the emplacement during hours of drill. Instruction of the first section embraced all subjects included in the gunners' examination, the same being made as practical as possible. The scope of this instruction was subsequently extended as will be noted. Instruction of the second section included arithmetic, especially fractions—common and decimal; practical cordage, drill, &c. Members of the second section were advanced to the first section as soon as they acquired the necessary knowledge.

On account of the limited time before the annual examination in 1900, and particularly because of the lack of qualified instructors, it was not possible to further sub-divide the sections. The result of the examination for 1900 was as follows.

| | |
|---|---|
| First class gunners | 4 |
| Second " " | 5 |
| Third " " | 8 |
| Unclassified (those who failed) | 11 |
| Total number examined | 28 |

Immediately upon completion of this examination the company was again carefully examined with the view of classifying the non-gunners.

Effort was made to utilize the qualified gunners as instructors, but it was not successful, and the instruction was conducted as has already been outlined. The result of the annual examination for 1901 was as follows:

| | |
|---|---|
| First class gunners | 47 |
| Second " " | 9 |

| | |
|---|---|
| Unclassified (those who failed) | 9 |
| Total number examined | 65 |

This examination was completed December 24. In January, 1902, a more carefully considered system was introduced. Men who had qualified as first class gunners in previous years were examined as to their ability to impart instruction. They were then given a preliminary course of instruction—one month—and were then duly graded as instructors.

The company was examined as in previous years and classified, with the result that fifty-eight men were considered qualified to pursue the regular course of instruction. The company was divided into fourteen squads, twelve containing four men each and two, five each. An instructor was assigned to each squad and held strictly responsible for their instruction. The subjects included in the course were:

1st. Angle Measuring Instruments.
2nd. Drill and Nomenclature.
3rd. Sights and Gun Commander Tables.
4th. Plotting Boards and Difference Charts.
5th. Cordage and Mechanical Manœuvres.
6th. Powders, Projectiles and Fuzes.
7th. Barometers, Thermometers and Anemometers.

Two squads were assigned to the same subject simultaneously.

Two weeks was the period allowed in which a squad should become proficient, at the end of which time the individual members were examined by the Captain or Lieutenant, or in some cases by the First Sergeant. Those who successfully stood these preliminary examinations were advanced to another subject, while those who failed were required to pursue the same subject until proficient. The squads were thus re-arranged semi-monthly, the number of men in the squads remaining uniform. As a rule the men were able to master the subject within the allowed time.

As was to have been anticipated, some men failed to become proficient even after persistent effort, but as long as they indicated a desire to learn and were attentive, they were encouraged to continue their efforts.

Occasionally an instructor failed to devote the necessary time and attention to his squad. In such cases extra recitation hours during the afternoon and evening were assigned, during which he was required to be present to give instruction to men who desired to continue their work. It was found that there were always men who availed themselves of these additional opportunities to improve themselves. A roster of the class was posted in the recreation room of the company barracks, upon which was noted the standing of each man, *i. e.*, what he had accomplished and what remained to be done.

As soon as all of the squads had completed the course they were consolidated for review and further instruction under personal direction of the Captain, which instruction continued daily until the annual examination. The result of the examination was as follows:

| | |
|---|---|
| First class gunners | 7 |
| Second " " | 14 |
| Unclassified | 14 |
| Total number examined | 35 |

The reduction in the membership of the gunners' class was due to discharge of men upon expiration of term of service. Immediately after examination, a new manning table was made and individual instruction given in accordance therewith, especial attention being devoted to telephony and all details of the plotting room, the conditions at the guns during actual practice being reproduced as nearly as possible.

Very Respectfully,
Willoughby Walke,
Captain Artillery Corps,
Com'd'g. 13th Co., C. A.

### Coast Defense in France.

A decision taken by the French Upper War Board—the Conseil Supérieur de la Guerre—at its last sitting has attracted considerable attention in this country, and will doubtless be of interest to all States which have to deal with the problem of coast defense. It has been decided to entrust in future to the Naval Prefects, by way of a permanent delegation of power from the Ministry of War, the command of the artillery in all batteries facing the sea. To-day the popular Republican organ, the *Petit Parisien*, cordially approves of this reform, which has been carried in agreement with the naval authorities, and gives an instructive survey of the changes that occurred before its adoption. It points out that according to French law the Ministry of War is responsible for the defense of the national territory. Consequently, the task of the navy is confined to defending the coast from the sea, the only means at its disposal for doing so being its ships. But it is scarcely conceivable that the two departments of War and of Marine could fulfil their respective duties without sometimes overstepping the limits of their jurisdiction. Joint action is necessary, and therefore the question arises as to which department should have the supreme command of the combined forces. Is it the army, which disposes of the troops and the batteries on land, or the navy, whose scouts have discovered the enemy and whose cruisers, torpedo-boats, and ironclads converge their fire upon him in conjunction with the coast fortifications? The importance of securing unity in the command was generally admitted, but there was great difficulty in putting it into practice owing to questions of *personnel* and material. If the latter considerations alone were taken into account, it would seem quite natural that the Ministry of War should be entrusted with the defense of the coasts. But it is necessary to consider not merely the source from which the *personnel* is drawn, but also the aptitude for the service, and it is from this point of view that the partisans of the naval command of the coast have gained the upper hand.

After a reference to the conditions of naval warfare on the coast, the writer argues that the defense should be divided between the Ministries of War and of Marine according to the stages of the attack. Instead of taking that view, however, the decree of 1894 divided the coast into sections, which were commanded by officers of the army or of the navy, according to their estimated importance from the standpoint of maritime or land defense. That arrangement, which was based neither on the provision of the *personnel* nor of the material, nor calculated upon the stages of the enemy's operations, gave rise to confusion, in which it was very difficult to fix the responsibility. In 1901 the Ministry of War, in concert with the naval authorities, appointed the Maritime Prefects to be governors of the localities were the naval arsenals were situated. The question of coast defense, which was left open on that occasion, has now been solved by the latest decision of the Upper Board of War, which secures the independence of the maritime operations while preserving the legal responsibility of the Ministry of War. In conclusion, the *Petit Parisien* says that the details of the new organization still remain to be settled.

—*London Times*, March 4, 1903.

## MISCELLANEA.

The commanders of the French warships which took part in the recent submarine maneuvers at Cherbourg have sent in reports to the Minister of Marine giving their opinion freely regarding the result of the maneuvers. These reports, according to Reuter's agency, may be summarized as follows:

1. It will be possible for submarines to leave their station, and a squadron will never be in safety at moorings situated within the radius of submarines.

2. A battleship or any naval force would make a great mistake if it moored within the radius of action of submarines.

3. Watches on board ship are of no avail, and artillery fire is ineffective against submarines. The supervision of an anchorage, either by means of torpedo-boats or torpedo-boat destroyers, is very difficult, and does not really render the vessel secure against submarines.

4. A squadron would only be really safe in a closed harbor with the entrance protected by electric wires.

5. Attacks in the open sea or in rough weather must be carried out by submersible boats or by autonomous submarines of a large pattern. Torpedoes carried by destroyers would only be a feeble weapon against submarines, because they could carry only a small quantity of explosives—about twenty kilogrammes—and thus the action of the torpedo would be quite limited. A torpedo exploding at a few yards distance from the hull of a submarine would probably do it no damage.

6. Admiral Makaroff's invention, which comprises a microphonic apparatus, would be almost useless. The indication given by it would in every case be insufficient.

7. It is perfectly possible to arrange at the entrance of a harbor an instrument indicating changes of position, but that would aid the defense of an anchorage but little, and that of a vessel at sea not at all.

—*United Service Gazette.*

There is an article in the *Moniteur de la Flotte* upon the Mediterranean maneuvers and the escape of the squadron from Argostoli. The conclusion reached is that a prudent blockade must be maintained by vessels at a distance, giving security from torpedo attack in the night but having little chance of being efficacious. On the other hand, a squadron attempting a close blockade would subject itself to great danger. The writer remarks that the French have acquired a certain proficiency in night operations, and that the event at Argostoli shows that they are on the right path, and that maneuvering at night without signals will be a necessity in the warfare of the future.

—*Army and Navy Gazette.*

The increase made in late years in the energy of guns can be illustrated by two examples taken from the United States navy. A few years ago the 6-inch gun was 30 calibres in length and weighed 4.8 tons; its muzzle velocity was 2000 foot-seconds, using brown powder and 100 pound projectiles; its corresponding muzzle energy was 2773 foot-tons, and its practicable rate of fire was two and one-half aimed shots per minute, its muzzle energy per minute was therefore 6932 foot-tons. The latest type of 6-inch gun is 50 calibres in length and weighs 3.2 tons; its muzzle energy, using smokeless powder and a 100 pound projectile, is 5836 foot-tons; it practicable rate of fire is eight aimed shots per minute, and its muzzle energy per minute therefore is 46,688 foot-tons, or more than 600 per cent. greater than that of the 30 calibre guns using brown powder. —*The Engineer*, London.

*Danzer's Armee-Zeitung* states that during October, 1902, some interesting experiments in shooting were made at the Steinfeld range in connection with the school of gunnery for the Austrian garrison artillery. An old, but still serviceable searchlight, was placed at a distance unknown to the gunners and illuminated at night. Fire was then opened on it from a battery of six 4.7 guns, and within five minutes from the first round the mirrors of the searchlight were broken to pieces. A second searchlight was hit after a few rounds had been expended in getting the range. The distance was about 2,200 yards. During the daytime a captive balloon of about 10 feet in diameter, was fired at. The distance was 3,300 yards, and the balloon was some hundreds of feet in the air (the height is not stated more definitely). After 20 rounds a shrapnel shell exploded close to the balloon, from which issued a long stream of fire, and the balloon fell rapidly to the earth.

The *Army and Navy Gazette* says that increased attention seems to be paid in the Russian army to military ballooning. Each year officers are detailed to attend the theoretical and practical courses at the balloon establishment. The theoretical course lasts from December to May, and relates to the history and present state of ballooning, and the use of military pigeons, meteorology, applied mechanics, photography, fortress warfare, etc. The practical work consists in the use of various balloon apparatus and in the making of captive and free ascents. Moreover, in 1902 the ballooning sections have had great opportunities of gaining experience at the grand maneuvers at Kursk. At the conclusion of the course all those who have satisfied the examiners are entitled to wear the special badge indicating their proficiency.

The German field artillery, although entirely new within the last four years, is to be again completely overhauled for the fitting of every gun with new recoil action upon the hydraulic brake principle, which has been perfected by the French. It is anticipated that the change will involve an expenditure of at least a million sterling. —*United Service Gazette.*

The "*Jahrbucher fur die Deutsche Armee und Marine*" states that the committee appointed to decide upon a suitable gun for the Swiss artillery, has finally chosen a Krupp gun, model of 1902, in which the gun recoils upon the carriage, and the gunners are protected by a shield after the manner of the gun in use for the last few years in the French army. (It will be remembered that a previous committee had decided upon an Ehrhardt gun, but in consequence of the success of the French gun the matter was referred back for further consideration.) The gun now chosen has a weight, without its carriage, of 826.74 pounds, its carriage and accessories without the shield, weigh 1,245.61 pounds, or with shield 1,358.04 pounds; the gun and carriage together weigh 2,074.54 pounds, or with shield 2,184.78 pounds, (19½ cwt.) The muzzle velocity is 1,591 feet; and the velocity at 3,280 yards, 905 feet per second. The range, with an elevation of 5 degress, is 2,890 yards, of 10 degrees 4,650, and of 15 degrees 6,140 yards. The French system of sighting and laying the gun was considered too complicated and unreliable, and a system proposed by the Creusot firm was also rejected. The system adopted gives automatically the required angle of elevation, and permits the change from direct to indirect firing to be easily made.

# BOOK REVIEWS.

**The New International Encyclopedia. New York: Dodd, Mead and Company. 1902. Volumes II, III, IV, V.**

The first five volumes of this comprehensive and valuable work are now before the public, and the successive volumes as they appear do but confirm the judgment passed on the First Volume, namely, that this encyclopedia has taken its place as the standard, and will probably hold this position for at least a decade or two to come.

The character of the work in general scope and reliability may be judged somewhat, at least in a general way, from the character and reputation of its principal editors. These are Daniel Coit Gilman, LL.D., for a quarter of a century the President of John's Hopkins University, now President of Carnegie Institution, a man respected and beloved by all who come in contact with him, with an international reputation in the field of education; Harry Thurston Peck, Ph.D., L.H.D., Professor in Columbia University and Frank Moore Colby, M.A., late Professor of Economics in New York University, both men of high reputation in their special work. These have been assisted by professors from the principal Universities and colleges of the country, and by other specialists of national and international reputation.

The Second Volume covers the words from ARMFELDT to BIGELOW, and contains five colored plates (Azalias, Beetles, Indian Baskets, etc.,) ten maps, and thirty-five full page engravings, besides a number of wood cuts in the text. The colored plates are generally beautiful specimens of art, while the maps are all that could be desired. A special feature is the numerous maps of cities, with names of streets and important buidings and land-marks indicated. The engravings are also very artistic and clear; some of the more interesting ones in this second volume are one on Armor, representing the different styles of armor worn by warriors from the stone age to the nineteenth century; a plate on historical artillery weapons; a restoration of the Palace of Sargon, representing Assyrian architecture; a beautiful restoration of Athens; a splendid reproduction of the bust of Marcus Aurelius in the Berlin gallery; the lovely Bambino from the sculpture by Andrea Della Robbia in Florence; the Basilica of St. Paul's without the walls, Rome; Beethoven, from the painting by Carl Stieler, in the possession of the Countess Von Saneman, Berlin; and the magnificent Doge Leonardo Loredano, from the painting in the National Gallery, London. The encyclopedia, in this respect, constitutes a real art album. So much for the *Beautiful*. Turning now to the *Useful* we we will merely call attention to one plate, representing Barns: four diagrams, representing a $450 barn of ordinary form, giving perspective view, front elevation and interior construction, and two diagrams of a two-story circular barn. The other ptates relate to natural history (bees, bats, bears, bass, barnacles, beaver, beech, babboons, ash trees, army worm, auk, etc.), athletics, automobiles and other subjects.

The principal articles in this volume are: Armies, Armor Plate, Army Organization, Art, Artillery, Asia, Automobiles, Assyria, Astronomy, Athens, Ballistics, Battle, Beetle, Belgium, Berlin, and Bible. The value of the work to the *military* student is thus clearly evident, especially as all these articles are written by men of acknowledged authority in their special branches.

One of the best features of the encyclopedia is the bibliography at the end of each article, and the usefulness of the work (for reference)is also vastly increased by the cross-references to other words bearing on the same subject.

Volume III. is adorned with six colored plates, eight maps of cities and countries, and thirty-eight full-page engravings. The most beautiful colored plates are those of Birds of Paradise and Indian Blankets. Most of the maps are double-page. The engravings include Bismarck (from the painting of Franz von Lenbach), the Book Plate of the Grolier Club, Botticelli's Primavera (a beautiful reproduction), Krämers painting' of Burns, the interior of the Church of St. Sophia, and the bronze bust of Cesar in the Berlin Museum.

There are many articles on military subjects, the most complete and elaborate being that on Military Bridges.

Volume IV. has the usual number of plates, maps and engravings, and their character is similar to those of the preceding volumes. The works of art represented are Canterbury Cathedral, Caravaggio's Entombment of Christ, Krämer's portrait of Thomas Carlyle, and Benvenuto Cellini's Perseus. The military subjects are Cavalry (the uniforms from the revolution to 1902) and Coast Artillery (the present guns and mortars), as well as a map of the operations in the Civil War.

Volume V. has a splendid colored plate representing Pompeian Mural Decoration, which is one of the most beautiful reproductions in the entire work thus far, and also the lovely Corregio,—The Holy Night, in the Dresden Gallery. Here are also the Arch of Constantine, the Cologne Cathedral, Columbus (from the Capitoline Gallery, Rome), Copernicus from the painting by Brausewetter), Dante (from a portrait by Giotto, in the National Gallery, Florence), David's Coronation of Josephine, Demosthenes (Vatican, Rome,) and a fine portrait of Darwin. One of the most interesting articles in this volume is that on Costume, which is also well illustrated. The principal military articles are Military Courts, Crimean War and Demolition.

This, the last volume issued, carries the work to include the word DESIDERIUS.

It is impossible to give an accurate idea of the scope, variety, accuracy, beauty and utility of this magnificent work in every branch of art and science, but some of its more prominent features will be recognized from our brief notice, and some idea of its general character may perhaps be derived from our imperfect description. The elements we have referred to in more or less detail are the characteristic ones of this new Encyclopedia,—those in which it appears to us to excel. It has, of course, the usual historical articles (as well as the scientific, literary and other), and these are brought up to date and corrected by the latest available material on the subjects. The article on De Koven, for example, refers to *Maid Marion* (1901), and that on Cromwell refers to Theodore Roosevelt's *Oliver Cromwell* (1900), to merely mention the first two historical articles we happened to find on opening volume V. Others come up to 1902.

Every encyclopedia should probably be judged by a different standard, since each may excel in a different direction, but the *New International* appears to us to be the most generally useful of them all, because it was written with that object in view by men accustomed to using encyclopedias very frequently, because that was the constant aim of the publishers as well, and because the best critics have so adjudged it. Exhaustive essays on particular subjects were carefully avoided, and only such matter as belongs strictly to an encyclopedia was included. It is sufficiently general to be readable and handy, and sufficiently detailed to be interesting and useful.

J. P. W.

**Traccia per lo Studio della Fortificazione Permanente. E. Rocchi, Lieutenant-Colonel of Engineers. Torino: Tipografia Roux e Viarengo. 1902. Pp. viii+449. O. with 90 separate plates.**

This book by Colonel Rocchi, the eminent Italian specialist on this Art, and published with the approval of the Inspector General of Engineers, is intended as a guide in teaching the subject of permanent fortification at the Italian School of Application for Artillery and Engineers at Turin. The Minister of War appreciating the necessity of modernising this course of instruction required a work which would serve as a general basis, giving the guiding principles of the art, the new program of instruction and a concise adaptation of these principles to the course as thus outlined.

With this object in view, Colonel Rocchi undertook the task. He has produced this work which is remarkable for its clearness and conciseness, yet omits none of the essential and practical details of this vast subject.

The book is not a complete treatise on permanent fortification, but rather serves to indicate the manner in which study thereof should be pursued and points out the salient features in the development of the art which should then be the subject of further study and investigation.

The author gives first the guiding principles that should obtain in a rational study of the art of permanent fortification, and deduces therefrom a complete analytical program of instruction which he then develops in six chapters; 1, General features and history of the art of fortification; 2, details of fortification, materials employed; 3, land fortresses, including mountain forts; 4, defense of coasts and coast fortifications; 5, attack and defense of fortified places; 6, rôle and use of fortifications in the defense of States.

The historical chapter forms only a preface, as it were, to the more detailed study of the modern art of fortification and especially of armored fortification. This study, illustrated by numerous plates, is exceedingly clear and instructive. The descriptions of modern fortified places will be found interesting; we may mention the Belgian fortifications on the Meuse; the forts at Molshein (Germany); the intrenched camps of Bucharest and Copenhagen, and the armored fort "Pampus" (Amsterdam).

The plates are numerous and handsomely reproduced. They illustrate the text fully and in themselves form a valuable review of the art of fortification from early times to the present day.

**Balistica Esterna. By Cap. di Fregata G. Ronca e Prof. A. Bassani. Livorno: Tipografia di Raffaello Giusti. 1901. Pp. xvi+487. O. Paper.**

**Manuale di Balistica Esterna. By Commandante G. Ronca. Livorno: Tipografia di Raffaello Giusti. 1901. Pp. xxxii+357. O. with 38 plates. Paper. Price of the two volumes: L. 14.**

**Manuale del Tiro. By Commandante G. Ronca, with an appendix on "No-**

**mography" by Prof. Pesci. Livorno: Tipografia di Raffaello Giusti, 1901. Pp. xvi+586+lvii. With 10 plates. Paper L. 10.**

These three volumes may be considered together, as they form a complete and logical exposition of the whole subject of theoretical and practical ballistics. Although three distinct volumes answering different requirements, they are yet parts of one comprehensive work and are so considered by the authors.

Charged by the Minister of Marine to compile a course of ballistics for the advanced class of the Naval Academy at Leghorn, and for officers preparing for examination, the authors have most thoroughly investigated the subject, and everything that is most modern in artillery science, and have presented their results in a wholly new and eminently practical manner.

The first volume is a treatise on exterior ballistics in which are discussed the principal known theories of ballistics; the properties of the trajectory in a vacuum; the laws of resistance of the air; analysis of ballistic methods; it concludes with three important chapters on causes which modify the flight of projectiles; computation of range tables, ballistic machines, and finally, the calculations of probability of fire. The methods of eminent ballisticians, Didion, Siacci, Vallier and others, are discussed and compared, and this leads to the exposition of the Ronca-Bassani method, which is new and wholly their own, its principal object being to simplify further Siacci's formulas, and to extend their application to greater angles of departure.

The second volume is a complement of the first and contains the corresponding *practical* results of the foregoing theoretical investigations and discussions. It treats of the elements necessary in ballistic computations; solutions of problems of fire; correction formulas; penetration formulas, and the construction of range tables. It contains also ballistic tables by various authorities (Otto, Siacci, Zaboudski, Braccialini, etc.,) and many original ones by the authors, for the solution of problems of fire. A brilliant graphic solution of such problems is also given.

Finally, the third volume forms the practical guide of the artilleryman in practice and in the solution of problems that may be presented in war. It gives some original and practical formulas for corrections, discusses the elements of fire, the effects of projectiles, penetration, etc., and then treats of the normal and practical rules for execution and regulation of fire from ships, coast batteries, fortress and position artillery and field artillery.

An interesting feature of the work consists in the application of graphical solutions to various problems by means of *abaci*. The appendix by Prof. Pesci is a short treatise on this new science of "nomography", an important branch of graphics, the object of which is to facilitate the solution of equations and problems by graphical means, by the construction of *abaci* of the variables.

The three volumes taken together may be considered one of the most important works on the subject of ballistics. With the arrangement adopted, the work is relatively readily read and the calculations followed, and its value and use for practical purposes is enhanced. The citation of authorities is carefully made throughout and credit given to the work af previous investigators. We may mention the names of Mayevski, Siacci, Chapel, Vallier, De Sparre, Braccialini, Zaboudsky, Otto, Bashforth, Cranz, amongst others, and among the officers of our service, those of Ingalls, Weaver (penetration formulæ) and Squier (photo-chronograph), as a slight indication of the extent of the authors' researches, and the thoroughness of their work, which has fittingly won the distinction of having been awarded a gold medal by the Minister of Marine of Italy.

**Practical Hints for Mounted Infantrymen. By Captain B. L. Anley, D. S. O., 2d. Essex Regiment. Second Edition-Revised. London: Gale and Polden, Ltd. 1902. Pp. viii.+42. Tt. Sixpence.**

This little book is based on the author's own experience in the field, and the formations, equipment, kits, etc., described, are those which, under the conditions of the South African campaign, were found to answer best. It is particularly useful in giving much practical information on what to wear, how it is carried, treatment of horses and tactics of scouting in countries like South Africa. It should prove interesting and suggestive to both officers and men in general going on field service.

**Patrolling in South Africa, with Hints on Training Scouts at Home. By Captain C. F. Vander Byl, 16th Lancers. Second Edition. Illustrated. London: Gale and Polden, Ltd. 1902. Pp. viii+79. Tt. Sixpence.**

A very instructive booklet on an all-important subject, based on experiences in the Boer war. The author's aim is to give some hints for the conduct of a reconnoitring patrol and suggestions as to the training of men as will enable them to carry out the duties of reconnoitring properly and efficiently. Detailed accounts are given, illustrated by sketches, of some patrols which actually took place in this war, and comments are made showing the mistakes made, and the points to be guarded against. The author's style is clear and to the point, and the book eminently practical and interesting.

**Lewis and Clark Journals. History of the expedition under the command of Captains Lewis and Clark to the Pacific, 1804-6. With maps. In three volumes. New York: New Amsterdam Book Company. 1902. Pp. 416, 410, 416. S. Cloth. $1.00 per volume.**

In view of the approaching centenary of the famous Lewis and Clark expedition to the sources of the Missouri, across the Rocky Mountains and down the Columbia River making known to the world of that day the great "Oregon country," these volumes appear opportunely. They are a reprint of the Philadelphia edition originally published in 1814, which has long been out of print.

Soon after the acquisition of Louisiana, the attention of the government was directed towards exploring and improving the new territory. Jefferson himself planned the expedition, and it is interesting to read his detailed and specific instructions to his then private secretary, Captain Meriwether Lewis, 1st Regiment of Infantry, who, with Captain Clark, also of the army, were put in command of the enterprise. Its purpose was to discover the courses and sources of the Missouri and the most convenient water communication thence to Pacific Ocean. The party consisted of nine young men from Kentucky, fourteen soldiers of the army, who volunteered their services, watermen and servants, and in addition, a corporal and six soldiers, who accompanied the expedition as far as the Mandan nation.

Then follows a succinct and circumstantial narrative of the proceedings of the expedition. The story of this journey, being the incidents of each day during the expedition, is fascinating and entertaining throughout. One gets a vivid impression of the character of the country traversed, its beauty, the immense quantities of game, the dangers encountered by the party, and the many difficulties they successfully overcame. But more especially is the life of the Indians fully depicted before they were influenced by contact with the whites. This history gives accurate and extended views of all these various tribes beyond the Mississippi when first seen by white men; their manners and habits, their traditions, pursuits, dress and tribal customs.

This work already occupies a permanent place in American literature, and the publishers are to be thanked for reproducing it in an attractive and convenient form readily accessible to all. Maps of some of the more important points in the journey accompany the text, and portraits of Captains Lewis and Clark add to the interest of the book. Those fond of thrilling adventures and descriptions of travel will undoubtedly find much satisfaction in the present work.

**The A B C of Photo-Micrography A Practical Handbook for Beginners. By W. H. Walmsley. New York: Tennant and Ward. 1902. Pp. viii + 155. D. With xiii plates. Cloth, $1.25 net.**

This little work is truly a practical guide for beginners in a fascinating field of photographic work. The lack of any American book dealing with this interesting and important branch of photography and the great need of an elementary introduction to photo-micrography, has led the author to prepare this excellent manual. The large standard works of Sternberg, Pringle, Spitta and others, are too learned, too scientific, for the beginner and therefore of but little use to him.

The author appreciating fully the struggles and failures of beginners in the art, deals with his subject in a plain but comprehensive and intensely practical way and the beginner who will study the A B C should find his difficulties vanish. It tells of all the known methods of combining the microscope and the camera and yet is written so simply that any amateur photographer can understand the methods described. It contains also many valuable hints applicable generally in photography.

Mr. Walmsley is a recognized authority in the photo-micrographic world, and has had a more varied and longer experience in the field than most of his co-workers; hence this handbook containing mainly the results of his own experience in this line should undoubtedly prove of much practical value to workers in this ever broadening field.

The book is well illustrated with half-tone engravings of photo-micrographs by the author, which add largely to its interest and value.

The publishers have done their part well in presenting the volume in attractive form, and in all respects it forms a worthy addition to the list of standard works on photography.

**Frankreichs Kusten-Verteidigung. Fur Offiziere aller Waffen. By W. Stavenhagen. Berlin: Richard Schröder, Verlagsbuchhandlung, 1902. Pp. 62. O. Paper. M. 2.**

This versatile author, well known as a military writer, presents in this pamphlet a very interesting study on coast defense in France. It cannot be considered an exhaustive treatise on the subject of coast defense proper, yet it contains a very great amount of information concerning the French coasts, and fortified ports with further remarks on France's outlying possessions and her naval establishment.

After a consideration of the geographical position of France in Europe, the general aspect, length and importance of her coasts, and the main outlines of her coast defense organization, the author proceeds to a detailed study of the coast itself commencing at the Straits of Dover. He gives the geographical features, maritime information with respect to tides, shoals, the difficulties or practicability of effecting landings, and the resulting considerations governing its defense ; the commercial and military ports especially are described, and information given about their harbors, anchorages, entrances, depths of water, docks, light houses, etc., their fortifications and strategic value.

The Atlantic and Mediterranean coasts are similarly treated. The most important fortified ports, Cherbourg, Brest and Toulon are illustrated by sketch maps that enable one to follow the text more readily.

Some omissions and deficiencies accur, and it would have been well to have indicated the sources from which some of the information was obtained, that the opinions of the author on the value of the fortified ports in general might be given their proper value.

A special chapter is devoted to Corsica and the north African coast, Tunis, Algiers, Bizerta, and after a few remarks on France's outlying supply stations, the work concludes with a short review on the personnel, material and organization of the French fleet and a comparison with the English.

Due to the increasing interest that is now being evinced in the subject of coast defense and in naval matters, this suggestive pamphlet, the motto of which is " most efficient coast defense constitutes the superior power of attack for the home fleet," well merits attention.

**Neue Kanonen? von v. Alten, Generalleutnant Z. D. Berlin: E. S. Mittler und Sohn, Kochstrasse 68-71. 1903. Pp. 41. Paper. Marks 1, 20.**

This pamphlet from the pen of General von Alten, one of the prominent German writers on tactics, forms an interesting addition to the numerous recent writings on the much-discussed subject of field guns with shields and recoil on the carriage and questions connected therewith. The author presents a clear and impartial exposition of the main points of the discussion, intended primarily for the general reader hence free from technicalities, and a readable argument on the necessity for new model field guns from the tactical point of view and that of their *use* in battle.

A gun with recoil on the carriage is favored, and its adoption is considered a necessity; shields are recommended and they should be able to stop steel shrapnel bullets. The 5 cm. gun of General Reichenau receives careful attention, but the conclusions reached are not in its favor. In the opinion of the author it has no future. Then the subject of projectiles is discussed, and the importance and necessity of shrapnel in battle against infantry and artillery fully developed.

The results arrived at by the author concerning calibre, ammunition supply, number of guns in the battery, employment of field howitzers and machine guns are concisely given in the concluding chapter. This well written work is a substantial addition to existing literature on this important subject of the necessary rearmament of field artillery.

## EXCHANGE AND BOOK NOTICES.

**[Books received will be *reviewed* as space becomes available.]**

**The Despatches of Field-Marshal the Duke of Wellington** during his campaigns in India, Denmark, Portugal, Spain, the Low Countries, and France, and relating to America, from 1799 to 1815. Selected and arranged by Walter Wood. New York: E. P. Dutton & Co. London: Grant Richards. 1902. Pp. xxxi+475. O. With index. Green cloth. $3 50 net.

**Electrical Instruments and Equipments of the U. S. Signal Corps.** Prepared under the direction of Brigadier-General A. W. Greely, Chief Signal Officer, U. S. Army, by Captain Edgar Russel, Signal Corps. Washington: Government Printing Office. 1902. Pp. 159. O. Cloth.

**Taschenbuch der Kriegsflotten, 1903.** 4th year. By B. Weyer Kapitänleutnant a. D. With 277 pictures and plans of ships. München: Verlag von J. F. Lehmann, 1903. Pp. 321. S. Blue cloth. Mk. 3.

**Regimental Duties Made Easy.** By Major S. T. Banning, 1st Bn. Royal Munster Fusiliers. Second edition: Revised. London: Gale & Polden, Ltd. 1902. Pp. xii+161. D. Five shillings.

**The Non-commissioned Officer's Guide to Promotion.** Lance-Corporal to Corporal and Corporal to Sergeant. New edition. London: Gale & Polden, Ltd. 1903. Pp. xvi+277. D. Three-and-Six.

**Catechism on Field Training.** By Captain Lascelles Davidson. Second edition, Revised and Edited by Major S. T. Banning. With illustrations and Explanatory Notes. London: Gale & Polden, Ltd. 1902. Pp. xiv+192. D. Two-and-Six.

In the list of periodicals published in our last issue, the subscription price of **Science and Industry**, published at Scranton, Pennsylvania, was erroneously stated. Instead of being $3.00, it is $1.00 per year. Considering the excellence of this monthly, we feel sure it should have a large number of readers.

The following periodicals should be added to the list as published:

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| **Memorial des Poudres et Salpêtres.** | *Quai des Grands-Augustins*, 55<br>*Paris, France.* | [*M. Poudres.*] | *Semi-annually.*<br>*Per year* 13 *Fr.* |
| **Ueberall.** | *Verlag: Boll and Pickardt,*<br>*Georgenstrasse* 23, *Berlin N. W.* | [*Ueberall.*] | *Weekly.*<br>*Per year M.* 23.60. |

## Letter to the Editor.

WASHINGTON BARRACKS, D. C., February 8, 1903.

The Editor, *Journal of the U. S. Artillery*,
Fort Monroe, Va.

DEAR SIR:

Having carefully read the review, or rather criticism, in the November-December, 1902, number of the *Journal*, on "The Gunner's Catechism," by Capt. Wm. R. Hamilton, and the undersigned, it appears that our critic in his attack upon this work has involved himself a little too much.

The errors which should be avoided in a work of this kind are pointed out very plainly. But the examples quoted to illustrate these faults are certainly unhappy selections from an adverse critic's point of view. It is stated that they were picked at random, and I can readily believe that this is the case. The selections indicate too plainly that the critic, feeling it his duty to find *some* fault, and being pressed for time, has jumped at random (as he says) upon the passages in the book in which he does not immediately comprehend the author's meaning, or about which he knows little, and has endeavored to show that they are either erroneous or absurd. I will jump "at random" on some of his remarks, and see how well they bear close inspection.

The question is asked, how are angles measured? and the answer is, by divisions termed degrees, minutes and seconds. Our critic says, "this is hardly accurate, *to say the least.*" If he will turn to the introduction of almost any elementary work on mathematics (an arithmetic preferably) he will find the following, viz: "A quantity is anything that can be increased, diminished and measured. A quantity is measured by finding how many times it contains another quantity taken as a standard or unit of measurement." Our text deals with gunnery in little enough space, and presupposes a knowledge of at least the rudiments of arithmetic. In case of an angle the standard or unit of measurement is the degree with its subdivisions, as stated. The under scored portion of the sentence quoted above is a stereotyped phrase, which is without any meaning in this case, as far as I can see.

"Horizontal" is defined as perpendicular to the direction of gravity, the direction of gravity being stated to be the direction in which objects fall at the point considered. Our critic says "this is evidently not intended." It *was* intended. This definition is the result of extended experience in the instruction of enlisted men, who have told us that the floor or the ground is horizontal. We are supported in this by scientific works. The carpenter uses the direction of gravity to determine the horizontal, by means of a plummet or level. How does our critic do it?

Fault is found with one of our remarks in regard to the vernier. It is said that it "conveys but little idea, etc." There has never been a book written, and never will be one written, that cannot have fault found with it. It is possible to make almost any argument appear absurd by quoting a selected portion thereof. The vernier is a device difficult for the average enlisted man to comprehend. Many artillery officers are totally unable to explain to his satisfaction its construction, and the theory of its use. For this reason, in the Gunner's Catechism, five pages are devoted to the construction and use of the vernier, of which our critic quotes the opening sentence. It is the belief of the authors that this device (the vernier) is explained as clearly and comprehensibly as possible both by a general discussion and a concrete example, aided by a diagram. We have never seen a text book that makes the matter clearer in as few words. If our critic has seen such a text book we would be glad to have him refer us to it.

The statement is made that the cups of the anemometer *should* be placed at the mean height of the trajectory. Our critic says he does not understand this, and quotes the tables to show that the mean height of the trajectory may be 844 feet or more for a 12-inch B. L. R. This is a woeful quibble. We do not state that the anemometer *must* be placed 844 feet above the gun. We do not recommend the building of a Tower of Babel to be crowned by an anemometer. It is folly, however, to suppose that an anemometer placed a few feet from the ground where the friction on the earth obstructs the wind, where trees and buildings may shelter the instrument, can give a perfectly accurate indication of the speed of the wind acting on the projectile, 844 up in the air. The ideal position for the anemometer, different for every shot possibly, would therefore be where the velocity of the wind acting upon it was the same as the mean velocity of the wind acting upon the projectile during the flight. This would be at about the mean height of the trajectory. This is what was meant by the question. I do not see how any right minded person could think otherwise. It is foolish to attempt to show the impracticability of placing the anemometer at the mean height of the trajectory. It is generally placed as high as possible, on the roof of the D. P. F. station.

The aneroid barometer is described as consisting of a box from which the air has been exhausted. The changes in the pressure of the atmosphere change the shape of the box, and these changes move a pointer which indicates the corresponding pressure of the atmosphere. Our critic, quoting this definition, follows it with an exclamation point, and wisely refrains from further criticism. I interpret the exclamation point as equivalent to "This is too absurd to discuss." I cannot see where the absurdity comes in. If "H. Jr." really meant this (and what else could he mean?) I am forced to the conclusion that he doesn't know what an aneroid barometer is, and beg leave to refer him to Johnson's "Theory and Practice of Surveying," 16th edition, p. 126, for his information. It must be borne in mind that this work is necessarily brief. That was the chief object in writing it, to reduce the huge mass of pamphlets through which the enlisted man had to wade, to a practicable volume. All definitions and explanations are as brief as was deemed compatible with clear understanding. It is not expected that this book, any more than any other text, will entirely obviate the necessity for instruction of the uninitiated.

Our critic deplores the lack of illustrations. It was not intended that the book should be crowded with illustrations. A man does not need illustrations of the parts of guns that he sees every day, and if he wants to study the azimuth instrument or the telescopic sight, it would be better to get the sight or instrument. He will never be examined on an instrument which he has had no opportunity to see. As to cordage, one can never learn it thoroughly except by having the knots made for him. Any descriptions are merely supplementary to this.

As to the zones of mortar fire, of which our critic notes that there is no mention, there had been nothing definite published on the subject at the time that the ms. of this book was completed. It was a subject on which enlisted men were not at that time ordinarily examined.

This covers nearly all of the criticisms made and serves to show the unworthy nature of them, and how poorly they support the critic's statement that the book needs revision.

The book is, of course, deficient in many respects, but our critic has failed to observe most of these in his effort to find fault "at random".

I request that this letter be published in the *Journal*.

Very respectfully,

P. S. Bond,

1st Lieutenant, Corps of Engineers.

We gladly publish the foregoing letter. No man, nor any body of men, is good enough, or wise enough, to dispense with the tonic of criticism. In all fairness, however, it was submitted to the reviewer, who makes the following comments.—Ed.

A perusal of the letter emphasizes the remark previously made that the *author's* point of view alone seems to be considered and that apparently none other can be appreciated in certain cases. The author violates one excellent rule of controversy: say what is true, of course, but mind that it is decently probable. Also it may be considered an axiom that one should never appear to doubt that the other side has performed the elementary duty of acquiring the proper elementary information unless there is demonstrative evidence to the contrary.

Far from feeling it a duty to find *some* fault and from being pressed for time, we leisurely studied the book some two or three weeks endeavoring to appreciate it from the point of view of those for whom it was intended, enlisted men and beginners in the science of gunnery.

For the author's benefit, it may be well to examine more closely some of his remarks.

**Angles.** Naturally, the arithmetical propositions stated are correct, but for information concerning angles we usually have recourse to books on geometry or trigonometry. It will be found that the right angle is generally the *unit of measure*. The *sexagesimal division*, though most commonly used, is only one of several ways of dividing the right angle; and there are also other ways of expressing the measure of an angle. Hence our charitably-disposed phrase, "to say the least," does seem to have some meaning in this connection. The statement given in the text is not an exact and accurate answer to the wholly *general* question propounded.

Horizontal. We refer the author again to the definition as given in the text. Our common sense forbids us to accept the meaning therein conveyed, due to the loose construction of the sentence.

Vernier. This paragraph will surely form interesting reading for artillery officers. We rub our eyes, exclaiming, "what is this mysterious device?"—Lo, simply a vernier! We are not giving information. Authors are supposed to know all that is written on a subject before writing themselves. However, if the *principle* upon which a vernier is constructed cannot be stated more accurately than is given in the text, all reference to *principle* had better be omitted.

Anemometer. We simply asked for information, and after eighteen lines of explanation, the matter is no clearer now than before. The quibble seems to be part of the author. It is impracticable to carry out the idea for extreme mean heights of trajectory, and "it is folly to suppose" that an instrument, placed near the surface of the ground for low mean heights, would give the correct value of the wind, yet these positions, for certain ranges, would be those required in the "ideal positions" suggested by the author. If it be foolish to attempt to show the impracticability of placing the instrument at the mean height of the trajectory, it seems equally foolish to state it *should* be placed at that height. Text books are usually consulted for information, not for the purpose of trying to find out what was intended, and meaningless phrases should preferably be omitted.

Aneroid Barometer. The author, it will be noticed, puts his own interpretation upon our comment. The point of view is, we confess, new to us. Sometimes, however, this punctuation expresses surprise and wonder (has been known to express even admiration); and truly this is the most wonderful definition of this instrument that we have read. Johnson's surveying is truly a mine of precious information, but it contains no such jewel as this.

In speaking of illustrations, we only voiced the opinions of several officers who had seen the book, and we had in mind simply its greater usefulness.

No especial emphasis was laid on zones of mortar fire, but it does seem necessary that something more than the mere statement of the maximum charges used in mortars should be given.

Three principal criticisms were directed against the book: 1. Omissions and deficiencies; 2, inaccuracies of expression; 3, inaccuracies of facts; examples of all of which were quoted. The author admits the first; makes no mention of the third, and by his letter shows that, with reference to those quoted, explanation of the second is deemed necessary. Hence it appears that a revision of the work is not only desirable but necessary. H. Jr.

# INDEX TO CURRENT MILITARY LITERATURE.

[For Abbreviations used in Index see first number of each *volume.*]

[Periodicals of November, December, 1902; January, February, 1903.]

## ARTILLERY MATERIAL.

A new tissue for cartridge bags.—**Int. Rev.**, Supplement 45.

Krupp pavilion at the Dusseldorf exposition; guns, mounts and armor.—**R. Marit, Brazil,** November.

Artillery at the Dusseldorf exposition.—**R. Artillerie,** January.

The Skoda works.—**Mitth. Art. u G.,** January.

Krupp 30.5 cm. coast gun.—**Mitth. Art. u. G.,** January.

Capped and uncapped projectiles.—**Eng.** January 2.

Armor-piercing projectiles.—**Eng'ing.,** February 13.

Classes of powders and their application in war.—**M. de Art.,** November, December, 1902.

Combustion and combustibles.—**R. de Mar.,** December.

Researches on delay of inflammation of powders.—**M. Poudres,** vol. xi., 2, 1901-1902.

Report on powders and explosives.—**M. Poudres,** vol. xi, 2.

Safety exploder for wet guncotton shells.—**Scien. Amer.,** January 24.

Test of the new 16-inch gun.—**Scien. Amer.,** January 31.

Weapons used in the recent South African war.—**R. Mil. Brazil,** October.

History of the question of shields on field guns.—**Armee,** November 7.

Development of Krupp field artillery material, M 1897.—**M. de Art.,** November.

Experiments with rapid-fire field guns.—**M. de Art.,** December.

Krupp mountain gun and material, M. 1901; experiments at Isvizzera.—**R. Artig.,** November.

Field mortars, 24 and 12 cm., Skoda system.—**R. Artig.,** November.

The question of shields on field gun carriages.—**Belgique M.,** January 4.

On the question of steel bullets and protective shields.—**Kriegstech.,** No. 1, 1903.

Artillery at the Dusseldorf exposition, Ehrhardt guns.—**Int. Rev.,** Supplement 46.

Heavy field howitzers the principal arm of the foot artillery, Germany.—**Ueberall,** No. 19, 1903.

The German field artillery before the alteration.—**Jahrbucher,** January.

Data relative to field, horse, and mountain artillery and heavy field artillery material of the various European powers.—**R. Artig.,** December.

Field artillery with shields or not (artillery questions).—**S. M. Blaetter,** January.

Krupp field howitzers recoiling on carriage.—**R. M. Suisse,** January.

General von Reichenau's field gun.—**R. M. Suisse,** December.

Material of field guns.—**S. M. Blaetter,** December.

Ehrhardt 5 cm. field gun.—**S. M. Blaetter,** November.

The French field artillery material.—**S. M. Blaetter,** November.

Battalion guns; machine and automatic guns.—**R. Artillerie,** December.

Description of the Maxim-Nordenfelt semi-automatic gun, 0.057 mm. 1A - 1898.—**Boletin,** November, December.

The Hotchkiss automatic machine gun.—**Eng'ing.**, February 20.

Telescopic sights of latest construction.—**Mitth. Art. u G.**, January; **S. M. Blaetter**, December.

Mechanism for rapid laying of field guns.—**R. Artig.**, December.

Levels and sighting mechanisms for field guns.—**Kriegstech**, No. 1, 1903.

A new system of gun-sighting.—**U. S. Gaz.**, January 24.

The Grenfell sighting and signalling gear.—**Eng'ing.**, January 16; February 13.

## AUTOMOBILES, BICYCLES, AEROSTATION.

Study on the dynamics of free balloons.—**Genie M.**, December.

A new English airship.—**Organ**, volume lxvi., No. 1.

Balloon farm where aerial war vessels are made.—**Pop. Mech.**, February 28.

Competition of German automobiles (tractors using alcohol).—**R. Artillerie**, November.

Military automobiles in England.—**Memoires I. C.**, November.

Mechanical traction and its application for war purposes.—**Cientifico**, November 15, December 1, 15.

Principal automobile trials of 1902.—**Genie C.**, January 24, 31.

Naval automobilism.—**Marine F.**, January 15.

Double automobile motors.—**Umschau**, February 7.

The automobile of 1902.—**Genie C.**, February 21.

The applicability of automobiles for military purposes.—**Kriegstech.**, No. 1, 1903.

Five-ton steam wagon.—**Eng'ing.**, January 2.

Steam wagon (illus.)—**Eng'ing.**, February 13.

Cyclist curiosities (change of speed).—**R. Artillerie**, November, December.

## BALLISTICS.

The vertical projection of the trajectory.—**R. Mil. Brazil**, October.

Experimental results on the subject of ricochets.—**Genie M.**, January.

Short study on the rifling of guns.—**M. de Art.**, December.

On the mode of combustion of powders.—**Kriegstech**, No. 1, 1903.

Ballistic apparatus.—**Mitth. Art. u G.**, January.

A few words on the application of the formulas of interior ballistics.—**A. Belge**, November, December.

Law of pressures in guns.—**M. Poudres**, volume xi., 2, 1901-1902.

The loss of work on firing guns due to the warming of the gun and remedy for same.—**Kriegstech.**, No. 1, 1903.

A new Krupp armor.—**R. Maritime**, December.

Krupp armor plates at the Dusseldorf exposition.—**R. Maritime**, December.

Increased effect of projectiles against improved armor plate.—**Rundschau**, January, 1903.

Progress in the development of ship's armor and naval guns in 1901.—**Seewesens**, No. 2, 1903.

## CHEMISTRY AND PHOTOGRAPHY.

On the production of nitro-napthalines.—**M. Poudres**, volume xi, 2, 1901-1902.

Stability tests for nitro-cellulose and nitro-cellulose powders.—**Frank. Inst.**, March.

New process of color photography.—**Scien. Amer.**, Supplement, January 24.

Photography in natural colors.—**Trans. Can. Inst.**, October, 1902.

New extra-rapid photographic plates.—**Genie C.**, February 7.

## DRILL REGULATIONS, MANEUVERS AND PRACTICE.

Organization of a practice ground for R. F. artillery.—**R. Artillerie**, November, December.

On the instruction and training of infantry soldiers in rifle shooting, both in the field and on the range.—**A. S. M. Zeit.** Beilage iii., 1902.

A Russian criticism on the German infantry : its instruction and training.—**Armee**, November 21, 28.

Position artillery firing against field works on the lower Buchberg.—**A. S. M. Zeit.**, January 10.

Use of range-finders in infantry battle.—**Wochenblatt**, December 31.

New French regulation on the supply of ammunition in campaign.—**Wochenblatt**, January 3, 7.

**Notes and impressions of the maneuvers 1902.—Cercle**, December 6, 13.

**The new practical instruction for the service of cavalry in the field, France. R. Cav., December.**

**New regulations for infantry maneuvers, France.—Cercle, January 24, 31 ; February 14. Belgique M., January 4.**

**The American maneuvers 1902 (coast defense).—Eng. Mil.**, December.

Periods for firing practice and maneuvers for 1903, Belgium.—**Belgique M.**, January 18.

Results of the Imperial German maneuvers, 1902.—**Int.Rev.**, Supplement 46.

Bulgarian maneuvers, 1902.—**Int. Rev.**, Supplement 46.

Draft of regulations for machine gun groups, German army.—**R. Univ.**, January, February.

Landing maneuvers in Tsing-tau.—**Ueberall**, No. 19, 1903.

Firing methods of the Russian field artillery, 1900.—**R. Artillerie**, January.

On fire training.—**S. M. Blaetter**, January.

A new system of infantry disposition and drill.—**A. & N. Gaz.**, February 7, February 21.

Outline of the conditon and training of French infantry.—**Sbornik**, October, November, 1902.

The Delhi maneuvers.—**U. S. Gaz.**, January 10, February 14.

The Imperial German maneuvers, 1902.—**R. M. Suisse**, January.

Imperial Austrian maneuvers in western Hungary. -**R. M. Suisse**, December.

Maneuvers in upper Savoy.—**R. M. Suisse**, December.

The regulations for horse artillery.—**Exercito**, January.

The French naval maneuvers, 1902. - **Seewesens**, No. 1.

The *Belleisle* experiments, 1902.—**R. Maritime**, December.

British naval target practice.—**Marine F.**, January 15.

French criticism of the French naval maneuvers of 1902.—**Rundschau**, February.

## ELECTRICITY.

Marconi telegraphy.—**R. Maritime**, December.

The Popp-Branly system of wireless telegraphy.—**Umschau**, January 17.

"Radler de Aquino" apparatus for transmitting orders.—**R. Marit. Brazil**, November.

Wireless telegraphy experiments on board the *Carlos Alberto*.—**R. G. de Marina**, January.

Applications of electricity to the transmission of orders (Siemens—Halske).—**R. G. de Marina**, January.

Record of the year in wireless telegraphy.—**Elec. Rev.**, January 10.

Wireless telegraphy by the Fessenden system.—**Elec. Rev.**, February 21.

Portable wireless telegraphy equipment in the German army.—**Scien. Amer.**, Supplement, February 28.

The incandescent electric lamp.—**Page Mag.**, January.

Electrical surfaces (plates and cables for lights).—**Génie M.**, December.

Electric lighting of Fort Dom Carlos I.—**Génie M.**, December.

The Nernst glow lamp.—**Frank. Inst.**, February.

The Hopkinson method of testing dynamos.—**Scien. and Indus.**, January.

Galvanic batteries.—**Eng. News**, February 19.

Direct-current turbine dynamos.—**Amer. Elec.**, March.

Laying a submarine cable.—**Elec. World.**, February 28.

Structural details of the Edison storage battery.—**Scien. Amer.**, February 7.

The use of storage batteries in electric distribution systems.—**Eng. Cleve**, February 2.

Edison automobile battery exhibited in N. Y.—**West. Elec.**, January 24.

Dry battery tests.—**Amer. Elec.**, February.

When is a storage battery fully charged.—**Scien. and Indus.**, February.

A convenient storage-battery installation.—**Phys. Rev.**, February.

Edison's new storage battery.—**Pop. Mech.**, February 28.

New alkaline storage battery.—**West. Elec.**, February 28.

Spongy antimony for storage batteries.—**West. Elec.**, February 28.

## ENGINEERING AND FORTIFICATIONS.

Relative permanence of steel and masonry construction.—**Trans. A. S. C. E.**, Volume xlix.

The present resources of field fortifications.—**Sbornik**, November 1902.

Corrosion of steel used in constructions—**Memoires I. C.**, November.

Substitution of metal for wood in boats of bridge equipages.—**Génie M.**, December.

Action of cement on iron.—**Genie M.**, December.

Armored beton.—**Stahl u. Eisen**, January 1, 15; February 1.

Progress realized in the construction of metallic bridges.—**Genie C.**, January 24.

Fluvial hydraulic laboratory at Carlsruhe.—**Genie C.**, January 24.

New hydraulic pressure apparatus:—**Genie C.**, January 17.

The dry-rot question.—**Mitth. Art. u. G.**, December.

Calculation on the capacity of canals.—**R. Artig.**, November.

A new system of levelling—**R. Artig.**, November.

Inspection of the work of the engineers in the entrenched camp of Lisbon.—**Eng. Mil.**, October, November, December.

Note on the inclined plane from Trafaria to Rapozeira (defenses of Lisbon).—**Eng. Mil.**, October.

Construction of intrenchments.—**Eng. Mil.**, November.

Posts of observation in infantry cover.—**Mitth. Art. u. G.**, January

New armored fortifications.—**Jahrbucher**, January.

Earth or armor for coast fortifications.—**Rundschau**, February.

Coast fortifications.—**Int. Rev.**, Supplement 45.

The modern fort.—**S. M. Blaetter,** January.

Metallic boats in bridge equipages.—**Génie C.,** February 14.

## ENGINES, BOILERS AND MECHANISM.

Boilers and steam engines at the Dusseldorf exposition.—**Memoires I. C.,** November.

Large gas engines.—**Memoires I. C.,** November.

Improved vaporizer for gas engines.—**Scien. Amer.,** January 24.

An automatic oil electric machine.—**Elec. Rev.,** January 24.

Absorption dynamometer.—**Génie C.,** December 27.

Steam engine fly-wheels.—**Scien. and Indus.,** January.

The simplicity of the compound engine.—**Scien. and Indus.,** January.

## METALLURGY.

Aluminum alloys.—**Scien. Amer.,** Supplement, January 24.

New methods and devices for hardening steel.—**Scien. and Indus.,** March.

Researches on steel containing high percentage of nickel.—**Génie C.,** December 27.

## MILITARY GEOGRAPHY.

The Panama canal.—**Proc. A. S. C. E.,** January; **Eng'ing.,** January 30; **Eng. News,** March 5.

The windward Islands of the West Indies.—**Trans. Can. Inst.,** October.

An engineering study of sea coasts.—**Eng. News,** February 19.

Development of Russian military power in the Black Sea.—**A. Marine,** January 25.

The new harbor of Cuxhaven.--**Ueberall,** No. 16, 1903.

The navigation of the Po and its future.—**R. Maritt.,** December.

On the project of an Elbe-Kiel canal.—**Zeitchr. I. A. V.,** January 16.

The port of Anzio, its importance as a harbor of refuge, its conditions and plans for improvement.—**R. Maritt.,** January.

Morocco.—**Umschau,** January 31.

The projected new canal works in Austro-Hungary.—**Seewesens,** No. 2, 1903.

## MILITARY HISTORY.

Joseph Brant in the American Revolution.—**Trans. Can. Inst.,** October.

The fall of Plevna, November 28, 1877.—**Sbornik,** November.

The story of the army gunboats.—**United Serv.,** March.

Studies of military history: The Thirty Year's War.—**Exercito,** December, 1902; January.

Material for a military history of Portugal.—**Exercito,** December, 1902.

The campaign in Virginia, 1864-65, an example of modern position warfare. —**Int. Rev.,** Beiheft 36.

History of the artillery, France.—**R. Univ.,** January, February.

Military results of the Boer war. - **A.S.M. Zeit.,** January 31.

Work of the R.R. section of the General Staff during the period of mobilization, 1859,—**Wochenblatt,** January 17.

Suworoff's operations against Moreau and Macdonald.—**S. M. Blaetter,** January.

Notes on artillery in the South African war.—**R. M. Suisse,** January.

The Italian campaign of 1859 and Napoleon III as an army leader—**S. M. Blaetter,** November, December.

The battle of Vaalkranz.—**A.S.M. Zeit.**, December 20, 1902.
History of the 4. Rheinbund-Regiments, Dukes of Saxony.—**Wochenblatt**, December 24, 1902, January 17, February 11.
The battle of Woerth.—**Wochenblatt**, December 24, 1902, January 24.
Guibert.—**Quest. Mil.**, November, December.
Campaign of the year V.—**Quest. Mil.**, November, December.
The northern Chinese army.—**A. Marine**, January 4.
The Polish Turkish-Tartar campaign in 1675.—**Organ**, lxv, 5.
Study on the use of the Austrian bridge equipage material in campaigns from 1848 to 1878.—**Organ**, lxv, 5.
Affairs in Venezuela.—**A. Marine**, January 18 ; **A.S·M. Zeit.**, January 3.
The infantry attack of the V. army corps in the battle of Woerth.—**Wochenblatt**, January 3.
Strasbourg: 1870.—**Cercle**, January 10, 17.
How Prussia prepared for her revenge, 1806-1813.—**R. Inf.**, January.
French militia and English militia in Canada.—**R. Inf.**, January.
The retreat on Mezières, September 1, 1870.—**R. Cav.**, December, January.
Army movements in 1870-71 and their lessons.—**R. M. Etrang.**, January.
Studies on the south African war.—**R. M. Etrang.**, January.
The train and its importance in wars.—**Ueberall**, No. 18, 1903.
The Spahis.—**A. Marine**, February 1.
The English in Siam.—**A. Marine**, February 1.
History of 6th Regiment mountain artillery.—**M. de Art.**, November.
Study of the Anglo-Boer war from the cavalry point of view.—**A. Belge**, November-December.
The battle ; historical study.—**Organ**, vol. lxvi, No. 1.
Contribution to the literature and history of the 1815 campaign.—**Jahrbucher**, January.
The chiefs of the French army.—**Jahrbucher**, January.
The operations of York's corps against the northern French fortresses, 1814.—**Beiheft**, No. 1, 1903.
The *Irene* in Philippine waters, 1896-1899.—**R. Maritime**, December.
Maritime glory and traditions of Portugal.—**Liga Nav.**, November, December.
Destruction of the Haytian cruiser *Crête-a-Pierrot* by the German gunboat *Panther*.—**Marine F.**, December 15.
The operations of the Russian fleet during 1853-54.—**Rundschau**, January.
The times of Admiral von Stosch.—**Rundschau**, January.
The naval battle of Manila.—**R. de Mar.**, December.
Our ships of war and their ancestors.—**R. Maritime**, January.

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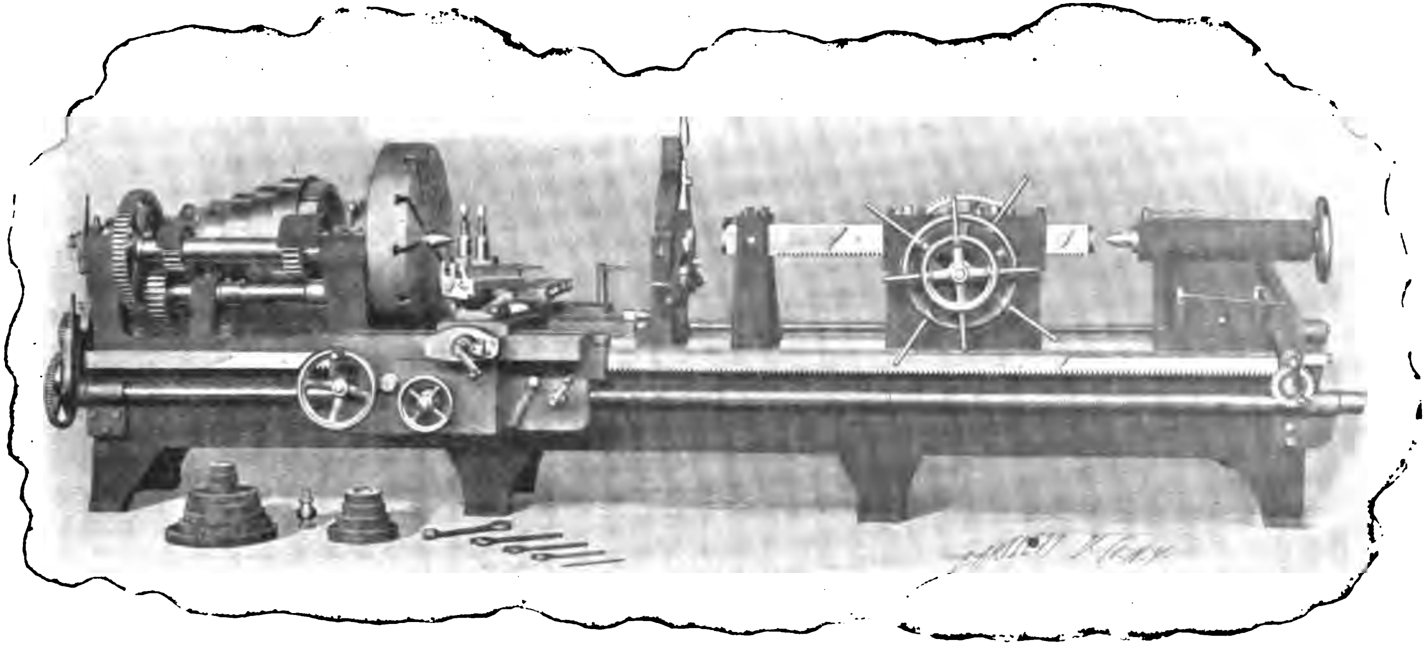

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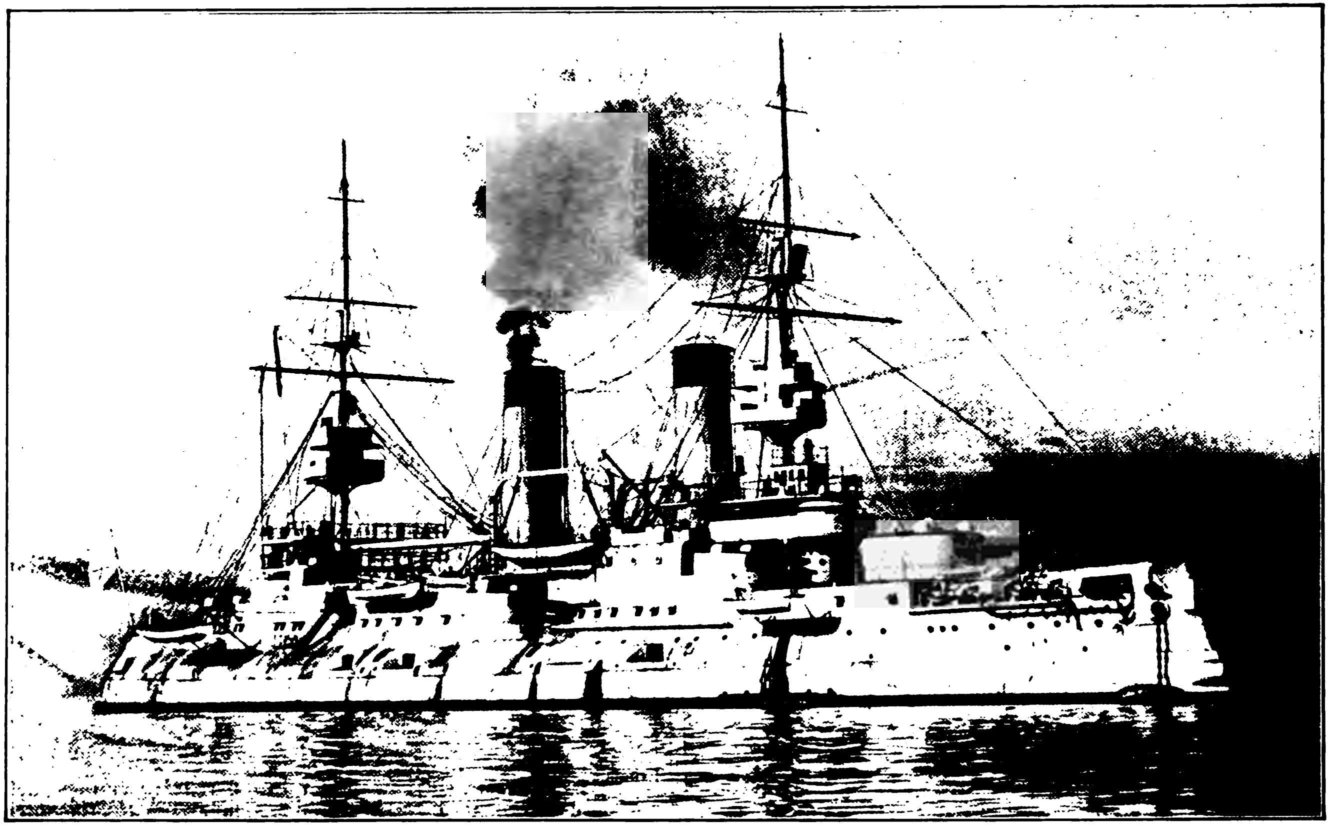

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JOURNAL
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# DEVIATING EFFECT OF WIND.

By A. G. GREENHILL.
PROFESSOR OF MATHEMATICS IN THE ORDNANCE COLLEGE,
WOOLWICH, ENGLAND.

Comparing the treatment of the wind problem by Major Whistler in the *Journal U. S. Artillery*, January-February, 1903, with his former theory as Lieutenant Whistler, in volume I. of the *Journal*, I much prefer his first point of view.

There is no such thing in my opinion as a separate direct deviating force of the wind on a body moving through the air, whether the body is a bird or a bullet, anymore than on a fish or Whitehead torpedo in moving water.

The bird flying out of still air into the wind finds himself bustled and unsteady for a few strokes of the wings, but quickly steadies himself down in the wind as in still air; and keeping his eye on the point he wishes to reach he steers his course with the due allowance for wind correction, just as a pilot does with a ship in a tide-way.

If it was possible for an elongated bullet to preserve the parallelism of its axis although moving with lee-way in the air, the bullet on issuing from the muzzle into a strong wind would have lee-way in the air equal to the wind velocity reversed. The resistance to the resultant motion relatively to the air would be the same as if the bullet was discharged sideways into still air; and supposing the resistance to this sidelong motion was known and assumed to act against the direction of motion, we should calculate the motion relatively to the air, and allow for the wind drift afterwards to obtain the motion relatively to the ground. This is the way to proceed with a spherical bullet.

But an elongated bullet requires to be spun by the rifling about its axis, to preserve the stability of its axial motion in the air medium ; otherwise in the absence of sufficient spin the bullet would tend to set itself broadside to the general direction of motion.

Now a bullet spinning in the air medium and advancing with lee-way cannot preserve the parallelism of its axis, any more than a spinning top can hold itself up in a fixed direction other than the vertical ; the axis in both cases must revolve about a mean direction, the vertical direction in the case of the top, and with the bullet the mean direction is that of the initial motion of the bullet relatively to the air.

With sufficient spin the axis both of the bullet and top tends in consequence of friction to steady down into the mean direction, so that the elongated and spherical bullet do not behave in a manner essentially different.

Having determined then the initial velocity of projection of the bullet *relatively to the wind*, we may suppose that the bullet like the bird will steady down very quickly into an axial motion in this direction, and now we calculate the motion of the bullet relatively to the wind ; afterwards the drift of the wind in the same time is applied to determine the motion of the bullet relatively to the ground. This was the method explained in my own article on the *Wind Problem in Gunnery*, published in this *Journal*, January, 1900, for the case of a cross wind.

For a head or rear wind the problem is complicated by the aberration in the angle of departure relatively to the wind, as well as by the relative velocity of the bullet in the air, due to the addition or subtraction of the wind on the muzzle velocity, and this seems to me to have been the method employed by the author in his first article in volume I., working on the formulas of Captain Ingalls.

The details are worked out afresh in the accompanying Note sent in by Captain J. H. Hardcastle, R.A. The general conclusion arrived at is that with small-arm bullets the wind correction becomes very soon nearly all wind drift ; whereas with heavy artillery projectiles the wind effect is practically insensible except at extreme ranges.

Ordnance College,
Woolwich,
March 30, 1903.

# SOME NOTES ON THE PRACTICAL EFFECT OF WIND ON RIFLED PROJECTILES.

By Captain J. HERSCHEL HARDCASTLE, Royal Garrison Artillery.

## INTRODUCTION.

The very first article in the very first number of the *Journal of the U. S. Artillery* was devoted to a sincere and praiseworthy effort on the part of Lieutenant J. W. Ruckman, to grapple with the problem of the effect of wind on the motion of a projectile, and since then the *Journal* has devoted much space to the discussion of this fascinating subject.

There have been some eight or ten different solutions or methods of attack propounded in various parts of the world, so that at one time it seemed almost hopeless to decide between the various claimants, for the disagreement of doctors has become proverbial.

Some two or three years ago when the writer had a good deal of spare time on his hands and was living almost next door to a rifle range it occurred to him to buy a rifle and learn to shoot it.

As soon as the preliminary difficulties had been overcome and the old lessons learnt with the Martini-Henry as a school boy had been remembered and practiced over again, the wind problem became a real actuality and ceased to have only a speculative attraction.

At once a choice had to be made from amongst the opinions of the doctors and the first was, although rash, yet perfectly natural, to disregard them all and treat the subject symptomatically pending a collection of trustworthy facts whereby to test the various theories.

Ay dint of shooting steadily in all weathers and questioning and cross-questioning all the more noted shots in the district, a certain set of facts were established and collated.

Then and not till then the evil spirit took his opportunity to pay the writer out for his pride in rejecting the opinions of the theorists and the revenge took the form of "Oh! that mine adversary had written a book."

He formulated a theory and spent six months in endeavoring to break it down. Failing, he felt sure it must be right as it fitted all the facts known to him about small-arms and their deviations. He wrote an article on it! But, by a stroke of luck, just before publishing it to the world and getting deservedly ridiculed for its absurdity, some good spirit put into his way the result of experiments with the old match-rifle and the theory was smashed to atoms and the article went into the waste-paper basket. Then the only thing to do was to collect all the published formulas and work them out for all sorts of guns and plot the results on squared paper comparing them with the known facts.

In the end the conclusion arrived at was that the behavior of a shot in the air was similar to that of a fish *in* the sea or a bird *in* the air and not to that of a boat on the water or an engine on a railway track.

Curiously enough this was the conclusion implicitly arrived at by Lieutenant Whistler and published by him in 1892 when discussing the accelerating and retarding effect of the wind. It was therefore rather a surprise to see the change in his opinions in the advance copy of the *Journal* for January 1903 which was kindly sent over to Woolwich a few weeks ago accompanied by an invitation to a discussion of the subject.

The following notes were written some months ago and have only been very slightly modified by the omission of all refinements of accuracy which are of only theoretical interest.

## I. EFFECT OF THE LATERAL DEVIATING COMPONENT OF THE WIND.

For a solution of the problem of the effect of wind on the flight of a rifled projectile, it is nearly useless to select any but the very smallest gun as a subject for experiment, because it is well known that the heavier the shot the less effect the wind has upon its deviations, and therefore their actual measurement becomes a matter of greater and greater difficulty as the caliber increases, owing to their bearing a continually decreasing ratio to the total deviation, composed of drift, wind and accidental errors.

No solution which only holds good for heavy guns and fails to give reasonable results for small-arms can be accepted as even approximately correct, so that for the actual demonstration of the truth or falsity of any solution offered, accurately shooting small-arms are the only weapons to use.

There are four rifles which have been shot so often during the last twenty years in England at target practice that their behavior in any given wind is perfectly well known to those who have used them.

The mean angles of departure necessary for any range up to

1100 yards are also known with great accuracy, as well as the mean initial velocity.

By the use of the formula

$$\sin 2\varphi = Ca$$

their respective trajectories can be solved for the ballistic constant $C$, and then by the use of the $S$ and $T$ tables their times of flight can be obtained with practical exactitude.

The results as tabulated below will be found substantially correct, any slight discrepancies being due to the occasional use of the slide-rule and to the smoothing of dishonest decimals.

PARTICULARS DETERMINED BY EXPERIMENT.

| Name. | Nominal caliber Inches. | Initial velocity in f.s. | Ballistic co-efficient | Angles of Departure Yards. | | |
|---|---|---|---|---|---|---|
| | | | | 500 | 800 | 1000 |
| Metford by Gibbs | 0.461 | 1320 | 0.64 | 1°0′ | 1°47′ | 2°23′ |
| Martini-Henry | 0.450 | 1320 | 0.40 | 1°8′ | 2°4′ | 2°47′ |
| Lee-Metford | 0.303 | 2000 | 0.42 | 0°30′ | 1°0′ | 1°42′ |
| Mannlicher | 0.256 | 2350 | 0.38 | 0°24′ | 0°50′ | 1°12′ |

*Times of flight calculated from above in seconds.*

| Range in yards. | 200 | 500 | 600 | 800 | 900 | 1000 |
|---|---|---|---|---|---|---|
| Metford by Gibbs. | 0.487 | 1.28 | 1.63 | 2.28 | 2.62 | 2.96 |
| Martini-Henry. | 0.505 | 1.42 | 1.76 | 2.48 | 2.88 | 3.29 |
| Lee-Metford. | 0.333 | 0.98 | 1.24 | 1.83 | 2.14 | 2.46 |
| Mannlicher. | 0.287 | 0.86 | 1.10 | 1.65 | 1.95 | 2.28 |

The experimental facts which have been established by frequent practice with these guns as to their behavior in a wind for lateral deviation are as follows:

(1) The Metford by Gibbs required much less deflection at all ranges than the Martini- Henry.

(2) The Lee-Metford requires more deflection for wind than the Metford by Gibbs, amounting at 800 yards to about 30%.

(3) At or beyond 800 yards the Mannlicher requires a trifle more deflection than the Lee-Metford.

(4) The Martini-Henry required much more deflection at 200 yards than the Lee-Metford but only a little more at the longer ranges.

(5) The rule of thumb at 800 yards for the Metford by Gibbs "give one minute deflection for each mile per hour of the wind" was practically correct.

If to these particulars we add the deflection published by Major Whistler for the 8-inch converted rifle for 4000 and 2000 yards, viz: 10.7 minutes and 2.72 minutes for a wind of 10 miles an hour, we have quite a reasonable number of experimental facts wherewith to compare theoretical results.*

It will at once be admitted by all serious people that a theory which accounts for all the known facts is far more likely to be the true theory than one which flagrantly contradicts those known facts.

The writer has been at pains to compare the known facts with all the published theories and finds that the explanation put forward by Professor A. G. Greenhill, F.R.S., in the text book of gunnery 1897 and also in the January 1900 number of the *Journal of the U. S. Artillery*, and ascribed by him to the late Captain F. Younghusband, R.N., is the only one which will bear comparison with facts, and the results it gives are so good that the probabilities in its favor are enormous.

These results can be expressed by the formula:

$$S = \left( t - \frac{3R}{V} \right) W \sin \theta$$

where $\theta$ = inclination of wind to the line of fire,

$S$ = deviation in feet,

$W$ = wind speed in feet-seconds,

$R$ = range in yards,

$V$ = initial velocity.

Using this formula and reducing the deviation in feet to minutes deflection, the following table gives the results obtained in minutes of deflection for each mile per hour of the wind blowing directly across, when $\sin \theta = 1.0$.

For the 8-inch converted rifle the results are approximately 12 and 3 minutes at 4000 yards and 2000 yards respectively.

The writer therefore submits that no one should now challenge the correctness of Captain Younghusband's theory without either contradicting or accounting for the figures and facts here given.

---

* The writer has results for heavy guns fired at Shoeburyness in his possession, which bear out his argument, but the information is marked "confidential" unfortunately, and so cannot be published.

| Range in yards. | 200 | 500 | 600 | 800 | 900 | 1000 |
|---|---|---|---|---|---|---|
| Metford by Gibbs. | 0.22 | 0.48 | 0.76 | 0.97 | 1.08 | 1.18 |
| Martini-Henry. | 0.48 | 1.12 | 1.32 | 1.68 | 1.87 | 2.03 |
| Lee-Metford. | 0.29 | 0.81 | 1.00 | 1.38 | 1.54 | 1.74 |
| Mannlicher. | 0.28 | 0.74 | 0.98 | 1.38 | 1.57 | 1.76 |

The formula given above is, however, not adapted for use on the range or firing point, but can readily be transformed into the shape

$$\beta' = \frac{N \times U}{P \times C} \sin \theta$$

where $N =$ the hundreds of yards in the range $= \frac{R}{100}$,

$U =$ velocity of wind in miles per hour,
$C =$ ballistic co-efficient of the projectile,
$P =$ 12 to 20, average 17,
$\beta' =$ minutes deflection required.

At first sight this working formula appears to be merely a rule of thumb and based on no particular theory, whereas it can be shown to be the same as Younghusband's if for $P$ we write

$$\frac{1320}{K_v},$$

where $K_v$ is the mean value of Bashforth's co-efficient for the cubic law of resistance of the air over the range.

For, writing the equation of the time of flight as

$$t = t_0 + a s + b s^2$$

we have

$a s =$ time of flight in vacuo,
$b s =$ delay in time of flight due to the air,

where

$$2b = \frac{K_v}{C \times 10^9}.$$

Therefore

$$t - \frac{3R}{V} = bs^2$$

$$= \frac{9 \times R^2 \times K_v}{C \times 2 \times 10^9}$$

$$= \frac{9 \times K_v \times 10^4 \times N^2}{2 \times 10^9 \times C}$$

and Younghusband's formula becomes

$$S \text{ feet} = \frac{U \times N^2}{C} \times \frac{1.47 \times 9 \times K_v}{2 \times 10^5},$$

or expressed in minutes of deflection

$$\beta' = \frac{U \times N^2 \times 11.46}{C \times N} \times \frac{1.47 \times 9 \times K_v}{2 \times 10^5}$$

$$= \frac{U \times N}{C} \times \frac{K_v}{1320}.$$

Turning to the table giving the values of $K_v$ it will be seen that between the velocities 650 and 2300, $K_v$ varies from 65.5 to to 109.6 so that $\frac{1320}{K_v}$ varies from 20 to 12, but the bulk of the useful values of $P$ will be found to lie between 15 and 20 because the lower values of $P$ are only useful for very light guns at short ranges where $\beta$ is negligible or for heavy guns at very long ranges, where other errors swamp the error in $P$.

For modern small bore rifles $P$ may be taken as 15 without sensible error and for guns up to about 6-inch caliber as 17, and as 20 for very heavy high velocity guns.

In any case, though, where great exactness is required as in target shooting it is as well to calculate the deflection exactly and make a direct reading chart on the lines of the attached wind-chart for the 0.303 rifle which the writer designed some while back for his own personal use.

It should be noted that with guns having a time of flight of about 16 seconds or more the shot rises to a height of 1000 feet at least, in which region the velocity of the wind is usually double the velocity close to the ground.

Beyond that height it is not safe to make any greater allowance, as the velocity increases then in a very variable fashion and may even remain constant or decrease, as has been shown by high flying kites.

### 2. EFFECT OF THE ACCELERATING COMPONENT OF WIND.

The effect of wind on range is also susceptible of calculation, following the same theory and the results tally with the records of practice.*

A following wind of $W$ f.s. velocity acting on a projectile whose initial velocity is $V$ f.s. and angle of elevation $\varphi'$ causes an altera-

---

* Again the only exact figures the writer possesses are "confidential."

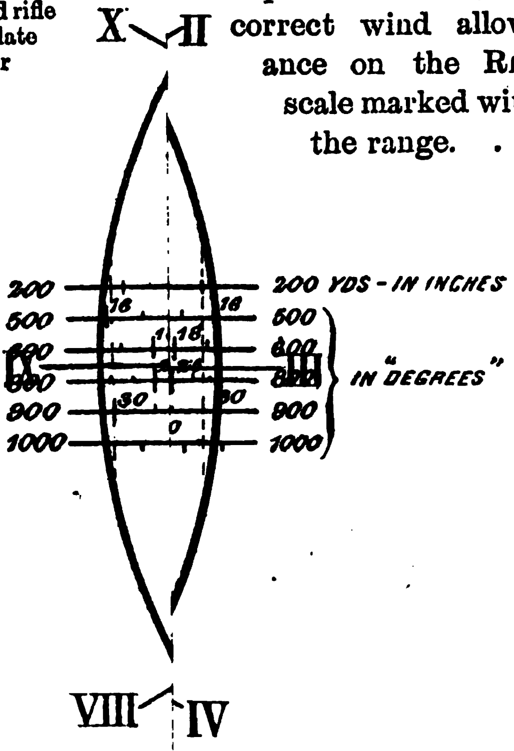
# WIND CHAmmunition.

The words used to describe th of the wind are those used in th weather forecasts, and the corres ing speeds have been obtained fr a Dines anemometer. . . .

The allowances are based upon the calculations used by the Royal Artillery, and also correspond with those used by celebrated rifle shots such as the late Mr. Metford & Sir Henry Halford, as published in various well-known books on the subject.

IONS.—Follow the circle d with the speed of the l till it cuts the "o'clock" the wind. . . . . .

Read off vertically under the point so found, the correct wind allowance on the Red scale marked with the range. . .



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*CAPT. J. H. HARI*

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tion in that angle of $\frac{W \times \varphi}{V}$ minutes, so that the angle of departure becomes $\varphi + \frac{W}{V}\varphi$ minutes. The projectile then moves through the air with a velocity of $(V - W)$ f.s.

The air itself moves with a velocity $W$ during the $t$ seconds of flight, carrying the projectile bodily with it a distance of $W \times t$ feet.

To calculate the total effect we must subtract from $\frac{W \times t}{3}$ yards, the change in the range caused by the reduced velocity and add the change in the range caused by the increased angle.

For a head wind the operation is precisely reversed.

The calculation of these various quantities is rather lengthy and involves the following operations to be at all precise.

For any range $R$ yards, determine $\frac{R}{C}$, $a$, $Ca$, $2\varphi$, $\varphi$, for the original initial velocity.

To $\varphi$ add $\frac{W}{V}\varphi$ and call the result $\varphi'$. Then determine in inverse order and with the reduced velocity, $2\varphi'$, $Ca$, $a$, $\frac{R'}{C}$ and finally $R'$.

Calculate $t$ with reduced velocity over the range $R'$ and then from $\frac{W \times t}{3}$ subtract $(R - R')$ and the answer is the total effect of the wind on the range of the shot.

In practice, however, it is safe to take $t$ as being unchanged and to take the effect of the change in angle from the column of the range table. Then it is only necessary to determine $\frac{R}{C}$ and "$a$" for the original velocity and keeping the same "$a$" but using the reduced velocity, work out another value of $\frac{R}{C}$ to suit it.

It is also exceedingly probable that even this slight amount of calculation could be avoided without introducing any appreciable error by the use of Siacci's formula

$$\frac{\Delta R}{R} = \frac{\tan \varphi}{\tan \beta} \times \frac{2\,\Delta V}{V}.$$

A curious point will be noticed after performing a few of these calculations.

Up to about 2° of elevation the amount to be subtracted from

$W \times t$ bears to it a large ratio, but as the elevation increases, the ratio diminishes rapidly and finally for long range the amount to be subtracted becomes negligible, so that for all practical purposes it is sufficient to say that the effect of wind on the range is the travel of the wind in the time of flight.

It is, however, more than possible that this compensating effect at short ranges is the cause of the chaotic state of the minds of most professional gunners on the subject of wind especially when combined with ignorance of the rate of increase of the average velocity of wind with the height of the trajectory.

Ordnance College,
Woolwich,
February 23, 1903.

# THE EFFECT OF ACCELERATING AND RETARDING WINDS UPON PROJECTILES.

By Major G. N. WHISTLER, Artillery Corps.

In the first volume of the *Journal of the United States Artillery*, page 235, will be found an article upon this subject. The present paper is merely a rearrangement of the original paper to make it conform to the change in nomenclature and notation now in use. I have also omitted certain portions of the argument which, at the time, were necessary in order to demonstrate the truth of the theory that wind effects were proportional to wind velocities, which was, at the time, in dispute, but which has since been admitted.

As will be seen by the formulæ used, the method herein stated applies only to direct fire; the same principle may, however, be applied to curved or high angle fire.

For a thorough comprehension of the subject it must be remembered that Ingalls' method is based upon the flight of a projectile "through quiescent air of uniform density," and this air is assumed to be at rest as referred to the earth; therefore the loss of velocity due to the resistance of the atmosphere for a given range is the same whether the distance is measured upon the earth, or considered as a function of the "quiescent air" through which the projectile passes in its flight. As the loss of velocity is a function of the resistance of the atmosphere, it is manifest that when the projectile is fired into a moving atmosphere, the loss of velocity as determined by Ingalls' Tables for a given horizontal flight, refers to the horizontal distance travelled through air of uniform density, which will differ from that measured upon the earth. Thus if a shot is fired in a head wind, and the range obtained, measured upon the earth, is 3,000 yards, it will have travelled through more than 3,000 yards of air. If, during the flight, the air has moved to the rear 100 yards, the shot will have travelled through 3,100 yards of air, and the loss of velocity will be that due to a travel of 9,100 feet of air, instead of 9,000 feet, as would be the case if fired in a calm. In order therefore, to apply Ingalls' formulæ, we must determine the values of $V$ and $v$, as referred to the air, which differ from their values as referred to the earth.

$V$, the velocity at the muzzle, is measured by the number of feet in space which the projectile would pass through in one second of time, if it was to continue to move at the rate it was moving when it left the muzzle. In order to apply Ingalls' formulæ to the case of moving air, we must obtain a value $V' =$ the number of feet of air which the projectile would pass through in one second, under the same hypothesis.

The projectile, in its flight, traces a curve in space which we call the trajectory. The *angle of departure* ($\varphi$) is the inclination of this curve at its origin. The projectile also traces a curve in the moving air, the inclination of this latter curve at its origin differs from that of the trajectory. We will denote this angle by ($\varphi'$).

In order to apply Ingalls' formulæ to the solution of this problem we must be able to determine the value of $V'$ and $\varphi'$ corresponding to any particular values of $V$ and $\varphi$, for a plus or minus accelerating wind effect of $U$ miles per hour.

### NOTATION USED.

$V$=Initial velocity referred to space.

$V'$=Initial velocity referred to the moving air, head wind.

$V''$=Initial velocity referred to the moving air, rear wind.

$\varphi$=Angle of departure of the trajectory in space.

$\varphi'$=Angle of departure of the trajectory traced in moving air, head wind.

$\varphi''$=Angle of departure of the trajectory traced in moving air, rear wind.

$U$=Velocity of the wind in miles per hour.

$U'$=22/15 $U$ velocity of wind in feet per second.

$X_0$=Range in feet, in calm.

$X_1$=Range in feet, in head wind, measured on the earth.

$X'$=Range in feet, in head wind, measured in the moving air.

$X_2$=Range in feet, in rear wind, measured on the earth.

$X''$=Range in feet, in rear wind, measured in the moving air.

$T_1$=Time of flight in head wind.

$T_2$=Time of flight in rear wind.

$A_1$=Ingalls' A referred to moving air head wind.

$A_2$=Ingalls' A referred to moving air rear wind.

$Z_1$=Ingalls' Z referred to moving air head wind.

$Z_2$=Ingalls' Z referred to moving air rear wind.

$T_1'$=Ingalls' T' referred to moving air head wind.

$T_2'$=Ingalls' T' referred to moving air head wind.

All reference to Ingalls' tables and formulæ refer to Artillery Circular M.

Now let us consider a shot fired in an accelerating wind of $+ U'$ feet per second, (head wind). $X_1$ is the range obtained measured on the earth during $T_1$ seconds time of flight. While the projectile has been travelling through this horizontal distance, the air has moved in the opposite direction through $U'\ T_1$ feet. We therefore have,

$$X' = X_1 + U'\ T_1. \qquad (1).$$

That is while the projectile has been traversing horizontally $X_1$ feet of space measured on the earth, it has passed horizontally through $X_1 + U'\ T_1$ feet of air.

In case of a shot fired in an accelerating wind of $-\ U'$ feet per second (rear wind), we would obtain,

$$X' = X_1 - U'\ T_1. \qquad (1').$$

All of the elements of the trajectory are functions of initial velocity, angle of projection, and the force of gravity. If the air is moving horizontally, the direction of the action of gravity referred to the direction of the moving air is the same as if the air was at rest.

If, therefore, we can determine the value of the initial velocity and angle of projection referred to this moving air, we can, by Ingalls' tables, determine all of the elements of the *trajectory traced in the air.*

That is if we know $V'$ and $\varphi'$ also $V''$ and $\varphi''$, we can determine $X'$, $X''$, and $T_1$, $T_2$ and as $U'$ is known, we can determine $X_1$ and $X_2$ from *Eq.* (1) and (1′) by solving for $X_1$ and $X_2$.

### HEAD WIND.

It is manifest that the *horizontal component* of the initial velocity referred to the earth $= V \cos \varphi$ and the *vertical component* $= V \sin \varphi$.

The *horizontal component* of the initial velocity referred to the moving air will be $V' \cos \varphi'$ and the *vertical component* $= V' \sin \varphi'$.

The velocity of the moving air referred to the earth is $+\ U'$ feet per second.

Therefore,

$$V' \cos \varphi' = V \cos \varphi + U'. \qquad (2).$$

As the air is assumed to have only a horizontal motion, the *vertical component* of the initial velocity is the same, whether referred to earth or air.

Therefore,

$$V' \sin \varphi' = V \sin \varphi. \qquad (3).$$

Dividing (2) by (3) we have,

$$\cot\varphi' = \frac{V\cos\varphi + U'}{V\sin\varphi} \qquad (4).$$

and from (3) we obtain,

$$V' = \frac{V\sin\varphi}{\sin\varphi'}. \qquad (5).$$

From *Eq.* (4) and (5) we readily obtain the values of $V'$ and $\varphi'$ when $V$ and $\varphi$ are known.

We now determine the value of $A_1$ from the following:

$$A_1 = \frac{\sin 2\varphi'}{C}. \qquad (6).$$

It is manifest that, as $\varphi'$ refers to the trajectory in air this value of $A$ also refers to the same trajectory.

With $V'$ and this value of $A_1$ we enter Table II and determine the values of $Z_1$ and $T'_1$.

We then have,

$$X' = C Z_1 \qquad (7).$$

$$T_1 = C T'_1 \sec\varphi'. \qquad (8).$$

As we now have the value of $X'$ and $T_1$ we can substitute these values in *Eq.* (1) and solving for $X_1$ we have,

$$X_1 = X' - U' T_1 \qquad (9).$$

or,

$$X_1 = X' - \tfrac{22}{15} U T_1 \qquad (9').$$

REAR WIND.

By a similar process of reasoning we obtain for a rear wind the following formulæ:

$$V'' \cos\varphi'' = \cos\varphi - U' \qquad (2'').$$

$$V'' \sin\varphi'' = V\sin\varphi \qquad (3'')..$$

$$\cot\varphi'' = \frac{V\cos\varphi - U'}{V\sin\varphi} \qquad (4'').$$

$$V'' = \frac{V\sin\varphi}{\sin\varphi''} \qquad (5'').$$

$$A_2 = \frac{\sin 2\varphi''}{C} \qquad (6'').$$

$$X'' = C Z_2 \qquad (7'').$$

$$T_2 = C T'_2 \sec\varphi'' \qquad (8'').$$

$$X_2 = X'' + U' T_2 \text{ or } = X'' + \tfrac{22}{15} U T. \qquad (9'').$$

### DISCUSSION OF THE FORMULÆ.

From *Eq.* (4) we obtain,

$$\cot \varphi' - \cot \varphi = \frac{U'}{V \sin \varphi} \qquad \text{or } \Delta \cot \varphi = \frac{U'}{V \sin \varphi}$$

From *Eq.* (4'') we obtain,

$$\cot \varphi - \cot \varphi'' = \frac{U'}{V \sin \varphi} \qquad \text{or } \Delta \cot \varphi = \frac{U'}{V \sin \varphi}$$

From which it is manifest that for the same initial velocity and angle of projection, the variation of cot $\varphi$ is the same for either a head or rear wind.

We may therefore write;

$$\Delta \cot \varphi = \frac{22\, U}{15\, V \sin \varphi} \qquad (10).$$

We may write *Eqs.* (4) and (4'') in the following form,

$$\frac{V' \cos \varphi'}{V' \sin \varphi'} = \frac{V \cos \varphi + U'}{V \sin \varphi} \qquad (4).$$

$$\frac{V'' \cos \varphi''}{V'' \sin \varphi''} = \frac{V \cos \varphi - U'}{V \sin \varphi} \qquad (4').$$

But, $V \sin \varphi = V' \sin \varphi' = V'' \sin \varphi''$, we therefore have:

$$V' \cos \varphi' = V \cos \varphi + U'$$

and,

$$V'' \cos \varphi'' = V \cos \varphi - U'$$

Dividing through by cos $\varphi$ we have,

$$\frac{V' \cos \varphi'}{\cos \varphi} = \frac{V \cos \varphi}{\cos \varphi} + \frac{U'}{\cos \varphi}$$

and,

$$\frac{V'' \cos \varphi''}{\cos \varphi} = \frac{V \cos \varphi}{\cos \varphi} - \frac{U'}{\cos \varphi}$$

For all conditions which can occur in Direct Fire $\frac{\cos \varphi'}{\cos \varphi}$ or $\frac{\cos \varphi''}{\cos \varphi}$ do not sensibly differ from unity.

We may therefore write,

$$\Delta V = V' - V = \frac{U'}{\cos \varphi}$$

and

$$\Delta V = V - V'' = \frac{U'}{\cos \varphi}.$$

From which it is manifest that for the same angle of projection and wind velocity the variation of $V$ is sensibly the same for either a head or rear wind, and we may therefore write:

$$\Delta V = \frac{22\ U}{15 \cos \varphi} \qquad (11).$$

Formulæ (10) and (11) are very valuable for the purpose of simplifying the work of computation. Formula (11) is not absolutely exact, but it is sufficiently exact for all cases of Direct Fire.

### FORMULÆ FOR CHECKING WORK.

From *Eq.* (4) and (4″) by the process used in obtaining (10) we readily obtain the following.

$$\cot \varphi' + \cot \varphi'' = 2 \cot \varphi \qquad (12).$$

By the process used in obtaining (11) we have,

$$V' + V' = 2\ V \qquad (13).$$

### PRACTICAL FORMULÆ.

In computing range tables we have given the gun and projectile to be used and the value of $V$. From this data we compute the values of $C$ and $\varphi$ for the various ranges. We then require the value of $\Delta X$ for a head or rear wind effect, usually for a velocity of one mile per hour. $U' = \frac{22}{15}$ f.s.

This is computed by the following method and by the use of the following formulæ.

To compute $\Delta V$ and $\Delta \cot \varphi$ we have,

$$\Delta \cot \varphi = \frac{22}{15\ V \sin \varphi} \qquad (A).$$

$$\Delta V = \frac{22}{15 \cos \varphi} \qquad (B).$$

To compute $\varphi'$ and $\varphi''$ we have,

$$\cot \varphi' = \cot \varphi - \Delta \cot \varphi \qquad (C).$$

$$\cot \varphi'' = \cot \varphi + \Delta \cot \varphi \qquad (D).$$

To compute $V'$ and $V''$, we have,

$$V' = V + \Delta V \qquad (E).$$

$$V'' = V - \Delta V \qquad (F).$$

We then use Ingalls' tables with the following formulæ.

$$\left.\begin{aligned} A_1 &= \frac{\sin 2\varphi'}{C} \\ A_2 &= \frac{\sin 2\varphi''}{C} \end{aligned}\right\} \text{(H).}$$

$$\left.\begin{aligned} X' &= C Z_1 \\ X'' &= C Z_2 \end{aligned}\right\} \text{(I).}$$

$$\left.\begin{aligned} T_1 &= C T'_1 \sec \varphi' \\ T_2 &= C T'_2 \sec \varphi'' \end{aligned}\right\} \text{(K).}$$

$Z_1$ is obtained by entering Table II. with $V'$ and $A_1$ as arguments.

$Z_2$ is obtained by entering Table II. with $V''$ and $A_2$ as arguments.

Having thus obtained the values of $X'$, $X''$, $T_1$ and $T_2$ we then use the following formulæ. For a wind of one mile per hour:

$$\left.\begin{aligned} X_1 &= X' + \tfrac{22}{15} T_1 \\ X^2 &= X'' - \tfrac{22}{15} T_2 \end{aligned}\right\} \text{(L).}$$

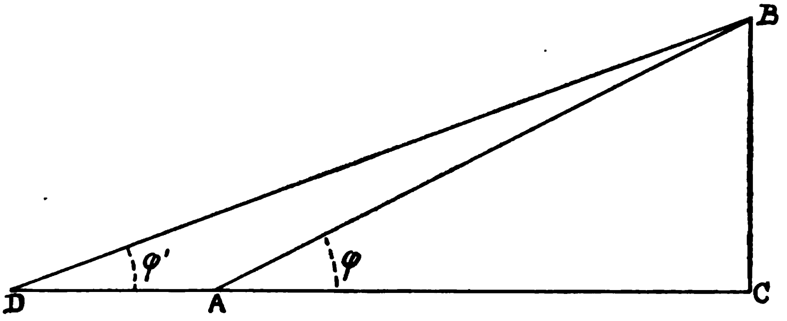
$$\left.\begin{aligned} \Delta X_1 &= X_0 - X_1 \\ \Delta X_2 &= X_2 - X_0 \end{aligned}\right\} \text{(M).}$$

$$\left.\Delta X = \frac{\Delta X_1 + \Delta X_2}{2}\right\} \text{(N).}$$

It is this mean value of $\Delta X$ which is directly proportional to the wind velocity and which is to be used in all B. C. Tables. See Discussion, Vol. I, *Artillery Journal*, page 235.

## CALCULUS DEMONSTRATION.

The fundamental equations (3) and (4) upon which this method is based may be deduced as follows.



Let $BAC = \varphi$ be the angle of departure of a shot fired in a wind, referred to the earth. Assume that the velocity remains constant during the interval of time $dt$. Let $A\,B$ be the space that would have been traversed by the shot had it continued to move as it was moving when it left the muzzle of the gun, for the time $dt$. Then will $A\,B = ds$, in which $s$ refers to the trajectory in space.

Now, while the projectile, under this hypothesis, has been moving from $A$ to $B$, assume that the air has moved from $A$ to $D$, that is, the particle of air which was at $A$ when the projectile started, would have reached $D$ when the shot reached $B$, had the velocity of the shot remained constant. (The word velocity as used here includes direction). As the air is moving $U'$ feet per second, $A\,D = U'\,dt$. Then $D\,B$ is the path which the projectile would have traced through the air in the time $dt$, had it continued to move as it was moving when it left the muzzle; consequently $D\,B = ds'$ in which $s'$ refers to the curve traced through the moving air. The angle $B\,D\,A = \varphi'$, that is the inclination of this latter curve at its origin, and $B\,A\,C = \varphi$, the inclination of the trajectory.

In the triangle $A\,B\,D$ we have,

$$A\,B : A\,D :: \sin A\,D\,B : \sin A\,B\,D$$

or

$$ds : U'\,dt :: \sin \varphi' : \sin (\varphi - \varphi')$$

or

$$U' = \frac{ds}{dt}\,\frac{\sin(\varphi-\varphi')}{\sin \varphi'}$$

But $\frac{ds}{dt} = V$ and $\sin(\varphi-\varphi') = \sin\varphi \cos\varphi' - \cos\varphi \sin\varphi'$

Substituting we have,

$$U' = V(\sin\varphi \cot\varphi' - \cos\varphi)$$

or

$$\cot\varphi' = \frac{V\cos\varphi + U'}{V\sin\varphi} \qquad (3).$$

From the triangles $B\,D\,C$ and $B\,A\,C$ we have,

$$B\,D \sin\varphi' = A\,B \sin\varphi$$

or

$$ds' \sin\varphi' = ds \sin\varphi$$

dividing by $dt$,

$$\frac{ds'}{dt}\sin\varphi' = \frac{ds}{dt}\sin\varphi$$

But $\frac{ds'}{dt} = V'$ and $\frac{ds}{dt} = V$

Therefore we have,

$$V' \sin \varphi' = V \sin \varphi$$

or

$$V' = \frac{V \sin \varphi}{\sin \varphi'} \qquad (4).$$

# REPORT ON THE WADSWORTH SYSTEM OF FIRE DIRECTION.

By Captain WILMOT E. ELLIS, Artillery Corps.

In accordance with instructions from the War Department, the system of Fire Direction proposed by Major Whistler was tested at Fort Armistead, Baltimore Harbor. It was entirely impracticable to test Fire Control with the means at hand.

The battery consisted of four guns mounted on disappearing carriages. The gun on the left flank of the battery was the directing gun. The B.C. station was on the right flank, in one of those emergency stations usually designated as a "Crow's Nest". The Rafferty D.P.F. was used for observing, and the Phillips' plotting board was employed to relocate the data for the directing gun. The B.C. station was connected with the guns by telephone only.

While I was not able to test the system in the thorough manner that I had desired, owing to the lack of proper apparatus and the short time available, yet my experience in these trials, and in certain experiments under Case II., combined with a careful theoretical study of the problem have led me to certain conclusions which are submitted herewith.

My first criticism of the Wadsworth method relates to the apparent insistence upon continuing observations until *four* points are located in a *straight* line. (First paragraph page 10). It is true that the pamphlet provides for making predictions based upon two observations, and Major Whistler in his comments upon Captains Haan's report calls attention to this fact. Two observations however will not determine whether the target is moving in a straight line or on a curved course. It would seem that at least three observations are necessary to determine the track of the vessel, and that the predicted point as well as the set-back point should be set off on the *indicated* course and not on a straight line.

Before discussing in detail the accuracy of the Wadsworth system, it will be necessary to determine as nearly as possible the minimum time elapsing between the epoch of last observation, and the instant of firing. I shall call this the "prediction interval."

This interval comprises seven operations, necessarily successive. Based upon my own judgment and experience, I have assigned to each operation what I consider to be a rational minimum time.

| No. of operation. | NATURE OF OPERATION. | Probable time in seconds. |
|---|---|---|
| 1. | Reading instrument for last observation of D.P.F. and locating corresponding point on plotting board. | 8 |
| 2. | Locating predicted point on the plotting board and determining its range and azimuth, | 12 |
| 3. | Applying all corrections in range and azimuth for the predicted point, for the directing gun. | 15 |
| 4. | Transmitting range and azimuth data to all guns. | 10 |
| 5. | Applying the difference chart at the gun and determining correct azimuth. | 20 |
| 6. | Laying the gun for prescribed azimuth. | 10 |
| 7. | Time required to report "Gun laid" to B. C. before guns are fired. | 5 |
| | Total time elapsed | 80 secs. |

The most probable form of attack will be either the "run-by" or a bombardment. Let us assume the most general case of an unlimited sea-way, and for simplicity of illustration, let us take the case of one battleship attacking one battery. In the "run-by", the target at long ranges would probably pursue something of an **S** shaped course, and in a bombardment, a series of loops.

I have been informed by competent naval authority that the tactical diameter of a battleship of the Kearsarge class, moving at the rate of 10 miles per hour is about 350 yards. By backing with the inner screw, this diameter could be materially reduced, but the use of the screw for backing in maneuvers, is, except in cases of emergency, generally prohibited.

Now on the "straight line" theory of prediction, the crucial test of the Wadsworth method will occur when the target starts to turn on its tactical circumference immediately after the last observation is taken. The probability that a vessel, hitherto pursuing a straight course, will change to a curved one at the instant the last observation is taken is exceedingly small; yet the same condition *obtains* if the target is moving on a curve during the observation period, and its position is predicted on the straight line idea.

In the following discussion and illustrations, I have taken a mean caliber (the 10-inch B.L.R.) with the standard M.V. for smokeless powder, 2250 f.s., and have assumed that 6500 yards is a fair mean range for "calculated fire."

If the target, with reference to the P.F. station, is moving approximately on the XII-VI line in either direction and on a curved course, fire will in general have to be withheld for the vessel will not in all probability come back to the predicted azimuth within reasonable time limits.

Figure 1 illustrates the case of a target moving on the III-IX line with reference to the P.F. station.

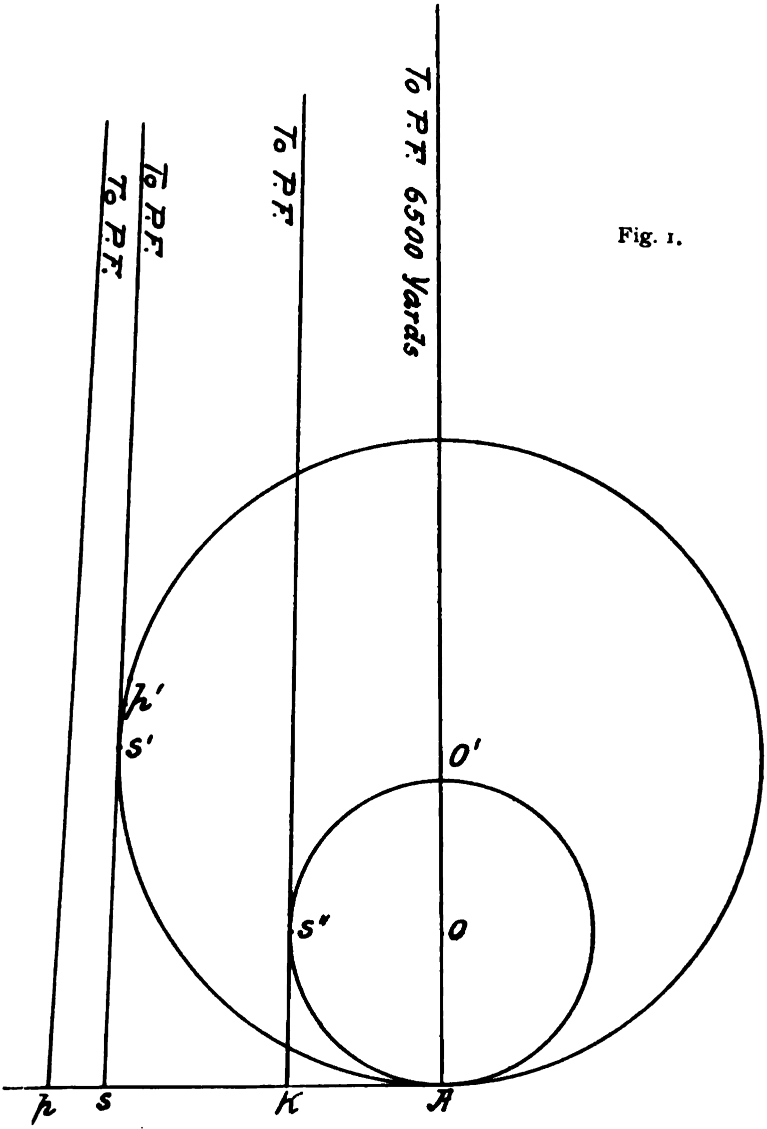


Fig. 1.

The circumference whose center is *O* represents the course of a battleship turning on its minimum tactical diameter at the rate of 10 miles per hour. $Ap$ is the line of prediction. If the set-back point is determined beyond $K$, the target will not come to the predicted azimuth. $s''$ is the position of the target at the end of 56 seconds. $AK$ represents a time interval of 35.5 seconds. In other words, for the case under discussion, the "prediction interval" would have to be reduced to 35.5 seconds, which is believed to be impracticable. If fire were delivered when the ship reaches $s''$ the range error would be about 230 yards.

$s$ is the hypothetical position of the target at the end of 80 seconds, $ps$ being the set-back. It is evident from the figure that if the ship maneuvered on any diameter less than that of the circle $As'p'$, it would not come to the predicted azimuth. This diameter is 740 yards; $p'$, if fire were delivered, represents the position of the target when the projectile arrives at $p$ and the corresponding range error would be about 460 yards.

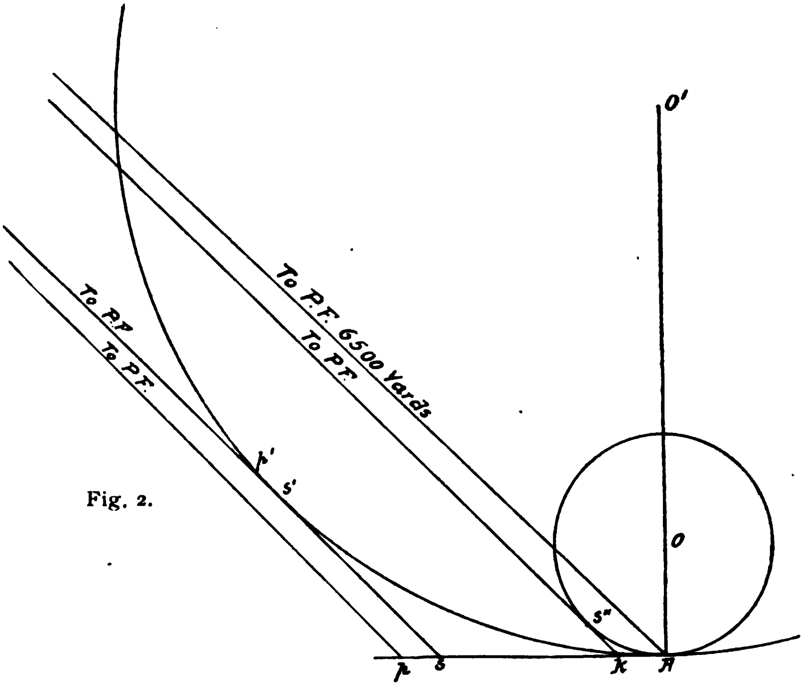


Fig. 2.

Figure 2 is intended to illustrate the state of affairs that may obtain when the target is "quartering" or moving on the 4:30-10:30 line. In this case the maximum tactical diameter is 1760 yards. The time required for the target to reach the azimuth of the set-back point would be 2 minutes and 27 seconds, and the range error would be 385 yards. As before, $O$ is the center of the minimum tactical circumference. *AK* corresponds to an interval of 15.5 seconds, a manifestly impracticable "prediction interval."*

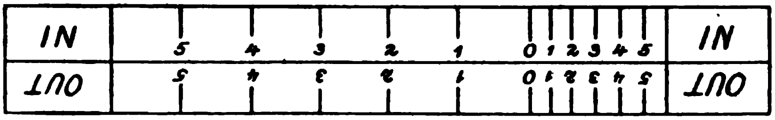
I think that the corrections as indicated in Plate VI. of the report are unduly refined. In my opinion range data should be correct to the nearest multiple of ten. If all corrections were made on the ten system, the resulting simplicity in calculation would be so obvious as not to require comment. Operation 3 of the prediction interval could be correspondingly reduced.

This would not result in sacrificing accuracy. The maximum possible error in each approximation would be five yards. For corrections due to four separate causes affecting the range, the maximum total error would be 20 yards, and this maximum error could occur only in that rare case, when each approximation involves a maximum error and *all* of the approximations are of the same sign.

As the smallest reading on the gun commander's scale is 20 yards, there seems to be no good reason why super-theoretical accuracy should not be sacrificed for the purpose of simplifying calculations. Furthermore, 20 yards is undoubtedly well within the mean longitudinal error of our coast guns at mean ranges. (It may be remarked, parenthentically that our service B. C. tables might be remodeled on the same basis; *i.e.* cutting out the tenth of units and integers not multiples of ten).

I would suggest an improvement in the auxiliary scale of Plate II. We found in our trials that some confusion resulted, due to the fact that the multiplying scale did not correspond to the fiducial edge. I use a ruler by the means of which the measuring scale and the multiplying scale are both laid off on the fiducial edge. One edge of the ruler is used for targets coming in the harbor and the other for targets going out. For drill purposes, probably both edges of the ruler will be required. Under service conditions only the "in" edge will be required. It is suggested that the space beyond the divisions on the median longitudinal line be painted red for the "in" edge and

(Fig. 3).



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* It will be observed that in the above discussion, the tactical circumference is tangent to the line of prediction at the point corresponding to the last observation, and that the distance as measured along the arc and the distance along the line of prediction for twenty seconds elapsing between observations are sensibly the same. This was assumed because the resulting geometrical construction was simpler and sufficiently accurate. It is apparent that in the general case, this assumption is perfectly fair to the Wadsworth method as the line of prediction is thrown in nearer to the tactical circumference.

white for the "out" edge.

### GENERAL REMARKS.

Case III. requires a higher degree of technical proficiency than Case II. In the first place, the work involing observations and corrections of range data at the B.C. station are about the same for the two cases, and furthermore the plotting board must be employed under III.

As I employ Case II. using the D. P. F., no plotting board is necessary. Captain L. S. Lyon in his article in the Journal of the Military Service Institution, November, 1902, states that during the manuevers last summer, a 10-inch battery at Fort Adams delivered fire at the rate of one salvo per minute, this without the use of the plotting board.

As far as the personnel at the gun is concerned, Case III. requires that one man should be able to use the difference chart accurately and quickly, and that another man should be able to lay the gun in azimuth accurately and quickly. As against this, under II., one man is required to sight the gun on the target, using the telescopic sight.

Fire can be delivered more rapidly under Case II. than under Case III. Operations 5, 6 and 7 of the prediction interval, (33 seconds) may be saved. Major Whistler's idea that fire should be delivered deliberately, beginning with a four minute interval at a long range, is believed to be untenable.

The probability is that under Case III. salvo fire will be more inaccurate. If any mistake is made in operations 1-4 (inclusive) of the "prediction interval", the fire of the whole battery would be wasted. If any error is made in operations 5 and 6, the fire of the individual gun will be wasted. Furthermore there is no way of checking these errors at the guns, as no direct sight is taken.

The probability of making errors in scale readings is much larger than is generally supposed. I find from my notes on the subject that in my examination of candidates for gunners last winter about 25% of the azimuth readings were wrong.

Major Whistler in his comments on Captain Haan's article seems to imply that the Wadsworth system is entirely independent of the time element and that the efficiency of Case II. is dependent upon the synchronism of time pieces. This is not necessarily so. As I employ Case II. the range of the target is determined at intervals of 30 seconds, and the gunner exercises a discretion as far as deflection is concerned, analogous to that exercised by the B.C. for range under Case III.

It would be a very interesting experiment to determine the comparative merits of the two systems by actual practice using a target moving in a sinuous course. Unfortunately however this is out of the question, as a towed target for manifest reasons cannot be made to pursue such a course.

I would recommend that a board composed of officers who have had experience under Case II. be instituted with a view of formulating a definite and detailed type system employing that Case, and that a similar board be instituted to formulate a system under Case III. Both systems, when approved, should be prescribed for use at all fortifications. Certain small variations from the standard in order to adapt the systems to the peculiarities of the local water approaches could be authorized by the artillery district commander.

# EARTH OR ARMOR PROTECTION FOR SEACOAST FORTIFICATIONS.

W. STAVENHAGEN.

TRANSLATED FROM THE GERMAN* BY CAPTAIN GEORGE BLAKELY, ARTILLERY CORPS.

Both from a tactical and technical point of view, steam, armor, and electricity have revolutionized naval warfare. These changes have brought with them an enlargement of naval problems both in war and in peace, yet the fundamental character of naval warfare remains essentially the same, for there is still the dependence on wind and weather, on the uncertain element of the sea, on a seaworthy crew, and a capable captain.

So it is with seacoast fortifications. The principles that govern their design and employment have changed in form alone, and on the whole less than is the case with interior land works. The same general rules for the location, arrangement, and use of seacoast fortifications hold to-day that were true at a time when armored steamships, rifled guns, armor-piercing shell, and torpedo boats were unknown. The chief purpose of these works is still to develop quickly a superior force in a combat with a fleet. Their strength has still to be proportioned to resist a powerful sea and land attack, although the means now at hand of bringing a heavy concentrated fire against their decisive points have made masonry an inadequate protection, and require armor for guns especially important or especially threatened. Coast fortifications just as interior land works are to be looked upon as the firm definite element in war, in contradistinction to the changing moving fleet, ever depending upon accident, and whose results are far less capable of prediction. To be sure the best defense of a coast lies in the possession of a superior attacking fleet, and hence this remains the most important factor. But an ever successful fleet is as little to be counted on as an ever successful army. Reliable coast fortifications are therefore an important element in coast defense, though not the most important, and this is especially true for states that are weak at sea, or exposed to a strong coalition. But this weighty factor, without which a coast is never completely defended, cannot be neglected even by a power so strong in its fleet as England, as is sufficiently shown by the feverish work now in progress on the south and east of the Atlantic's greatest island. It may be said with truth that the increased dependence of fleets upon coast fortifications as points of support has greatly enhanced the importance of such works.

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* Reprinted with permission from *Marine Rundschau*, February, 1903.

These considerations sufficiently justify a closer study of the most suitable design for coast fortifications, and in this paper especial attention will be given to the important question as to whether armor or earth is the best protection.

At first sight the question seems purely a technical one, yet indeed it is closely related to all branches of war by sea and land as well as to finance, so that from the first we must examine the question from a tactical and artillery point of view, and technics, which to-day seem capable of all, must be subordinated to these considerations. The armor manufacturer is not the master here but the soldier and the minister of finance. This is not infrequently forgotten. The technical qualities of the means of attack and their tactical use naturally influence above all other considerations the nature and form of seacoast fortifications, both as regards their artillery and their engineering features.

Men-of-war are built primarily for fighting one another, that is, for a battle at sea and not for an attack against coast fortifications. To utilize to the utmost the artillery and speed of the ship is the principal point, and this determines the construction, the armament, the armor, and the methods of fighting.

The strongest type, the battleship, in contradistinction to fortifications still lacks special mortar and howitzer fire. It is provided with flat trajectory guns only (10° to 15° elevation). Of these a few, (2 to 6), are heavy cannon from 24-cm. to 30.5 cm. (9.5 inches to 12 inches), for the older guns as large as 40 cm. (16 inches). It has about four times as many medium caliber guns, (10.5 to 17 cm., 4 inches to 7 inches), and twenty to thirty light rapid loading and machine guns. The ammunition supply, consisting of armor-piercing shell, fuzed shell and shrapnel is small in comparison to the supply usually maintained by coast fortifications. A ship will carry 100 rounds for the heaviest guns and 200 for the medium guns against four times as much provided for the coast guns. The unprotected portion of the ship—especially the unarmored portions of the sides—and the numerous frail parts of the superstructure are particularly exposed to direct fire, and this includes the portion of the ship where most of the crew are lodged. The vitals of the ship as an attacking machine are the water-line which secures the buoyancy, the ammunition magazines which preserve the fighting power, the boilers, engines, the screw shaft, and rudder, which make the ship capable of being moved and directed. These parts are protected against fire by an armored belt as much as 4 m. (13 feet) high and to-day, according to the material, from 18 to 25 cm. thick amidships (7 inches to 10 inches), if Krupp armor; if older armor as much as 40 cm. (16 inches). Recent ships have a thinner armored citadel about the middle to protect the medium artillery. The belt frequently does not reach more than ⅘ of the length of the ship, and is then closed by cross bulkheads.*

The armored deck is a flat arch, 5 to 10 cm. (2 inches to 4 inches) along the center and sloping to the sides of the ship with an increased thickness. This deck can only be reached by indirect fire. The turrets of the upper deck are either open, or closed against fragments. They vary from a thickness equal to that of the belt, as when used to protect the heavy guns or form a conning tower, to a thickness of 10 to 15 cm. (4 inches to 6 inches), when protecting medium and lighter guns. These turrets, as a rule, protect the carriage and not the guns, and are connected with the lower part of the ship by steel cylinders, which are not proof against armor-piercing shell.†

The guns are thus exposed to the danger of either being silenced or cut off from their ammunition supply. A single mortar shot striking, even at long range, might put a ship in the greatest peril by blowing up a magazine or boiler, and direct fire might reduce the crew so much as to put the ship out of action, as in the engagement with the Huascar in 1879. To cripple a ship it is not necessary therefore to penetrate the thickest armor like the belt. But the progress of artillery is such that even the thick armor of the belt is no absolute protection, though partitions and a cellular construction may limit the damage and preserve buoyancy and mobility. Krupp's 30.5 cm. (12-inch) seacoast cannon, length 40 caliber, penetrates all armor at practicable ranges: and so does the Vickers' lyddite shell, when furnished with the Johnson cap. The amount of armor that can be provided for a battery entrusted to the watery element is limited, and it must be remembered that the latest improvements are not adopted immediately in all nations, and all men-of-war are not of the latest type. In a discussion therefore we must assume an average type.

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* The armored portion of the ship was greater formerly than now, for the power of modern guns has required a thickening of the armor, and hence its limitation to protecting the guns and the vitals. Nickel steel has recently increased this protection But the crew has become more exposed by this change. The question of cost and weight make it probable that improvement in armor will result in reducing the thickness rather than in increasing the area covered Yet the recent advances in projectiles make a reduction in thickness problematical, and may indeed lead to a demand for more armor, which could only be met by increasing the displacement.

† The author has overlooked here the armor of the latest battleships Wittelsbach and H class.—Remark of the German editor.

Cruisers are still less fitted than battleships to cope with seacoast fortifications, on account of their weaker artillery and inferior protection ; at best they can but support the battleships ; their strength lies in their maneuvering qualities.

So ships of war must seek security for their vital parts by constant movement, and this circumstance increases the difficulty of their fighting successfully with the stable land works.

This movement of the ships affects the firing. On account of the motion, as well as on account of the difficulty of fire control and the small ammunition supply, a carefully conducted fire of precision lasting for days, as in formal land attacks, is out of the question ; the forts on the contrary will mass their fire quickly against the ships, which offer for a few hours large moving targets at close range.

The fire of the ships can hardly be very effective against the difficult targets offered by the coast fortifications,* hardly visible, scattered, and well covered, with other advantages which I will speak of later.†

Only by the expenditure of a very great amount of ammunition will quantity be able to make up for inaccuracy, as was the case for example at Lissa in 1866. This will seldom be practicable.‡

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* The difficulty of observing the fall of projectiles against scarcely visible batteries has recently been shown at Santiago de Cuba, where the poorly equipped works, with ten old bronze muzzle loaders, two 9 cm. and four 16 cm. (3.5-inch and 6.3-inch), were not silenced at any time by the American fleet with a superiority of guns, and which on June 6 alone fired against them 8000 shot.

† In 1813 Danzig-Weichselmunde was defended by the French. An English-Russian flotilla delivered 8500 shot between 10 o'clock in the morning and three o'clock in the afternoon, killing 16, and wounding 2 of the cannoneers. On the other hand two yawls were destroyed, and five hundred of the crew were killed or wounded. The two frigates were badly damaged, and the flotilla never reappeared. In 1814 the very ships that had won Aboukir and Trafalgar and burnt the Danish fleet at Copenhagen, had to give way not only to coast artillery but even to field artillery. In 1838 Fort St. John de Ulna was bombarded by the Franch under the Prince de Joinville with four frigates of 50 to 60 cannon and two bomb-ketches. In spite of an expenditure of 6000 shot and 500 bombs, the casemates of the 19 guns of the defense were found uninjured after the surrender. How often in older times were the slopes of Dunkirk and the citadel and tower at the entrance of the harbor of Havre dangerous to English ships. To-day it is not different ; armor on the one side is set off by armor on the other, an advantage of the attacker is constantly met by an advantage for the defender. All these examples prove one thing--the essence of the matter remains as it was.

‡ That a coast fortification left to itself may finally be captured by a fleet that goes about it properly, is for me as little a matter of question, as that every land fortification must finally yield to a superior enemy. The point is, that a delay is occasioned, which will usually be of such an extent that by it alone the works will have accomplished their purpose.

Ships of war, and especially thinly armored ones, must therefore avoid coming within range of, or engaging with, coast fortifications moderately well armed and constructed. Only as a means to an end is a combat with them permissible, never as an end in itself An attack by sea is demanded only when the special object in hand can not be attained otherwise. This might arise, for example, when the enemy's fleet after a defeat takes refuge behind coast works to escape loss at sea, and to prepare to renew the struggle, or when it seeks the protection and support of the works on account of an inferiority at sea. In such an event the enemy must be sought out in his covert, and the attacking ships must of course expose themnelves to the fire of the works and return it. Similar occasions will sometimes arise when a strait or channel is to be forced, or a landing secured, or important naval and harbor preparations and stores are to be captured or destroyed. Of course these last objects may be secured in other ways, as by steaming past at high speed, after removing or destroying any obstructions, or by seizing the works by surprise by a successful landing, or by destroying establishments or burning cities by bombardment at long range, without engaging the forts.

But even in the last case, it will usually be more a question of silencing the batteries that oppose the operations, than of a regular bombardment and destruction of ramparts, armor, and casemates. For this end the ships will choose as their tactics bombardment while in motion, in spite of the fact that this increases the inaccuracy, which is already considerable on account of the unstable platforms of the guns. At the same time the target presented to the defense is more difficult to hit, especially with coast mortars, which are very dangerous to a fleet lying at anchor. The individual ships, presenting their broadsides, will gradually approach the works, while constantly changing their range and course, and passing rapidly the zone most exposed to vertical fire, 7 to 4 km. (7700 to 4400 yards). At points considered particularly favorable, buoys will be thrown over, in order to find quickly again the range once determined. The real battle will take place between 4 and 1 km. (4400 to 1100 yards), to which inferior limit the ships must go in order to destroy armor. This will indeed be perilous, in view of the increasing penetration of the coast guns as the ships drew near, as well as the effect of the shrapnel on the badly protected crew, and the effect of the fire on the superstructure. Such a close range therefore will not be risked except in case of necessity;

as a rule, the decision of the combat must occur at ranges from 2 to 3 km. (2200 to 3300 yards).

Against an attack of the kind we have here outlined, in what position does the coast fortification find itself, and to oppose such an attack what provision must be made, especially as concerns the choice of earth work or armor as a cover?

A cover that does not lessen one's own fire is the only kind that tends to diminish that of the enemy. How does the question stand then, with reference to this requirement of fire action, which is always of first importance? As we have seen, the targets suddenly appear and move rapidly, but they are large, and readily seen, and tolerably well protected, though only the most vulnerable parts are covered by armor. Their defeat is therefore to be secured only by a large number of effective hits, especially as the ships carry a considerable number of guns, and can change their range and course in the greatest variety of ways, and withdraw quickly from the engagement.

Of first importance therefore is selection of the kind and caliber of gun adopted to insure accuracy and effect. The shell and shrapnel must be effective against the unarmored part of the ship, and the personnel on the deck; the armor-piercing shell must penetrate the belt, the turrets, redoubts, and deck.

Hence flat trajectory guns are necessary, supported by vertical fire cannon. The heaviest calibers seemed called for in order to have a shell with a large bursting charge, and to secure penetration at great ranges (12 km., 13,000 yards), at which ranges an effort may be made to hold the ships, or the ships themselves may at such ranges open the fire to harass the forts. Yet these heavy guns have the disadvantage of a relatively slow rate of fire, of a more difficult service, and greater cost. Now a ship is seldom put out of action by the penetration of its armor, especially at long ranges, and the end in view is generally better accomplished by a greater number of shell of medium size cannon, so that for about the same reasons as with ship artillery, the main body of the flat trajectory guns should be rapid fire pieces of from 15 to 21 cm. (6 inches to 8.5 inches), seldom 24 cm. (9.5 inches), which penetrate the thinner armor, and permit a reduction in the cost of one's own armor.

Only for some special purposes will a few 28 to 30.5 cm. (11-inch and 12-inch) guns be necessary.* On the other hand mortars and howitzers respectively should not fall below 28 and 21 cm. caliber (11 inches and 8.3 inches).* This is necessary to insure penetration of the armored deck, and to hold the fleet at a distance and prevent bombardment, for beyond 4 km. (4400 yards) the effect of vertical fire is a good deal more than direct fire, and the accuracy and time of flight is not very different, for at long ranges the trajectory of the guns is no longer very flat. The ships too on account of the long range will have to move slowly or come to anchor, and hence they are more easily followed by the mortars. Then too one of the very objects of the coast artillery is to prevent the ships anchoring and to compel them to move. Finally the vertical fire which ships presumably will carry in the future will have to be met by vertical fire. The coast mortar, which in past years has been recommended by Gribeauval, Gassendi, Larosière, D'Arçon, takes a very important place to-day.†

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* The 30.5 cm. (12-inch) Krupp coast cannon, length 40 caliber, on a center pivot carriage, penetrates 40 cm. and 49.5 cm respectively of nickel steel with hardened face at 1000 meters with its 350 and 415 kg. armor piering projectiles of 15,250 meter-tons muzzle velocity (muzzle velocities 620 and 820 meters respectively) at 2000 m. these projectiles under the same conditions penetrate 40 and 47 cm. respectively; at 3000 meters, 43 and 44.5 cm. They have thus more energy than required.

Last of all a large number of light and medium rapid-fire calibers, 7.5 cm. to 15 cm. (3-inch to 6-inch), are necessary to prevent landings or a forcing of the harbor, and to keep off reconnoitering torpedo boats, as well as to destroy the superstructure, unarmored parts, and the personnel, and to start fires. In spite of the movement of the ships, the probability of the guns of the fortifications hitting is good, for they are numerous, abundantly furnished with ammunition, laid scientifically, and the fire is carefully directed. Moreover their targets are large, easily observed from their first appearance, and their range can be estimated.‡

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* The 28 cm. (11-inch) howitzer, 12-caliber, center pivot carriage, made by the Krupp firm, can penetrate 9.7 cm. and 12.7 cm. respectively of a hardened steel armored deck with an angle of elevation of 43° and angle of fall of 52°, the projectiles weighing respectively 215 kg and 845 kg.; with an angle of elevation of 60° and an angle of fall of 67° the same projectiles penetrate respectively 13.3 and 17.1 cm. The ranges are the maximum fighting ranges.

† The Americans for their 31 entirely modern coast fortresses have, for example, only 356 heavy cannon (8-inch, 10-inch, and 12-inch), as against 544 mortars, and 1294 rapid-fire pieces from 6.2 to 15.2 cm. (2.5-inch to 6.7-inch).

‡ At 4000 m. (4400 yards) to include all shots, with 100 per cent distribution, a rectangle of 5.6 m. breadth and 10.8 m. height is necessary with the 28 cm. (11-inch) cannon; with the 28 cm. (11-inch) howitzer, the rectangle must be 12 m. broad and 96 m. long. Hence when an armored ship with a deck 100 m. long and 20 m. broad, and a height of 7 m., presents its broadside (which is advantageous for low batteries on account of the lateral dispersion), 92 per cent hits will be made by the guns and 26 per cent hits by the howitzers. If the ship is placed end on (which is advantageous for high batteries on account of longitudinal dispersion), it will receive all of the howitzer projectiles and 92 per cent from the guns. A part of the other of the flat trajectory projectiles will strike the deck, but unless the angle of fall is over 10°, they will not penetrate, provided the deck has a strength not less than one-fourth of the normal penetration of the projectile. The size of this angle depends upon the height of the battery above the surface of the water.

At 3000 m. (3300 yards) with the 28 cm. gun, 100 per cent, and at 7000 m. (7700 yards), 50 per cent of the shots will hit a ship 7 m. high and 20 m. broad.

If the enemy keeps in motion to avoid being struck, this in itself will be a gain, for his accuracy is thereby diminished. The most important object of the fire direction will be to render the ship unnavigable, or at least to put it out of action. Hence the shots should be concentrated on some vital point, and this should be the one least capable of resistance.

To attain such power and accuracy, a high degree of readiness for action is requisite, together with a permanent location of the gun, and abundant ammunition close at hand. Besides this, to follow the rapidly moving targets, there should be a wide field of view, and the guns should be able to train quickly, and fire rapidly, at ranges which are known, although the cannonade is not conducted after any formal plan. These requirements are usually met by a suitable construction of the piece and carriage, so that the manipulation in aiming and firing is readily performed, and the heavier weights in loading are handled by mechanical devices (lifts, trucks, cranes).

For the best action of the gun, firing over the parapet or through very wide apertures is the most suitable, as in open earth works. In the semi-circular parapet, a gun on a center pivot carriage can be trained as much as 150° in azimuth, and the field of view is unlimited. The rapidity of fire is diminished in disappearing carriages (much used in America), and these carriages require larger and costlier emplacements. But these disappearing guns retain the advantage of firing over the parapet. Armored batteries are therefore inferior to open earth ones, and this inferiority increases with their weight. In all kinds of armored batteries, the field of view is very restricted; turrets, however, can train 360° in azimuth, while armored casemates are limited to 60 to 80°. The light turret (15 cm., 6 inches) is therefore best for medium calibers.

The heavy turret requires too complicated a mechanism, and and this with its great weight retards the service, so that the rapidity of the fire against moving targets in very much reduced, even though the aiming can be facilitated by using a man-hole and sight slit. Nor can the mechanism be always relied upon to work. Then the first cost as well as the cost of maintenance must be considered, which generally leads to a double construction, which is also a drawback. For a single gun a turret enlarges the independance of the gun, increases the accuracy, forces the enemy to scatter his fire, is less vulnerable, and limits the damage to a single piece. Armored casemates are considerably cheaper than turrets, but their use is limited to special cases, where a large field of fire is not required, as for example shooting lengthwise down a harbor entrance, or where a frontal attack only is possible, and finally for the defense of a ditch or flank defense.

From the standpoint therefore of effective action open earth works deserve first consideration, for these give the gun a wide field, allow air and room for the cannoneers, and are easily equipped, and hence are adapted both to guns and mortars in the first line, especially those mounted on center pivot carriages. They will be of particular value when they can be placed at some height (10 to 30 m., 33 to 100 feet),* for this facilitates the range-finding, and increases the effectiveness of the fire against the deck and submerged part of the ship. This of course has its limits as we will show under the sub-head of "cover." The protection of armor increases the effectiveness of a battery only when thereby specially powerful guns can be kept at points otherwise too exposed, or when it is necessary to train the piece more than 150°.

Let us now consider the question from the standpoint of "cover." In the first line this has to be efficient against the solid projectiles, the shell fragments, and the shrapnel of the ships' guns, at present ships do not carry pieces for vertical fire. In the future these too will have to be reckoned with, as in the past they have played an important role.†

Schneider-Canet has already constructed 24 cm. (9.6-inch) ship-howitzers, with double armored shields, and elevations from — 7° to + 60°. Such fire will be employed by the attacking force to destroy hollow and vaulted structures, when islands, shallows, or stretches of coast lie near the sea batteries. Such works must therefore protect their roofs and masonry walls against mortar fire.

For the rest, provision must be made to resist a powerful flat trajectory fire, first of all armor-piercing and common shell striking full, and then fragments of shell and machine gun fire.

Shrapnel fire from medium and large sized guns, on account of the small angle of fall (7° to 10°), is effective only against low and easily observed targets.

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* Todleben says: "La cause principale du tir si efficace des batteries du Télégraphe et de la Guêpe était sans contredit leur position élevée."

† Already in the time of Louis XIV bombards had been introduced into the French navy, and were used in the expedition against Algiers in 1682 under Admiral Duquesne. Bomb-ketches were used by the English in their bombards of Saint Malo and Toulon in 1696 and 1707 respectively. Bombards existed in the Russian fleet on the Black sea in 1787. They were used again by the English in their bombardment of Copenhagen in 1801, in 1809 before Vlissingen, in 1816 before Algiers, in 1854 before Sveaborg and Kinburn, and in 1862 in the war of secession before Jackson, Philippeville [*sic*] and Vicksburg.

Let us now consider the existing material for cover, viz., armor and earth-work, from the point of view of their military value.*

To secure barbette fire earth offers only a frontal cover against vision and flat trajectory fire from in front. The measure of this protection is the height and thickness of the parapet.

Armor-piercing shell are not effective against earth cover of sufficient thickness, for the bursting charge is too weak. For that part of the target that appears above the parapet, a sufficient protection is found in its smallness, or in light armor. Shell with large bursting charge with delay action fuzes are, however, dangerous to earth works, as was shown at Düppel and Borgoforte, where the warks were rendered untenable by a single day's bombardment, and against Fort Rosabella where after about 1600 shell the parapet was cut down to the terre-plein. Yet Alexandria teaches us that a proper arrangement can secure protection, especially if mere sand be used, which gives no fragment, and also by sufficient thickness.

This can be calculated by taking into account the known striking velocity and the cross-section and material of the projectiles. Yet this is apt to lead to a superfluity of strength on account of an upward movement ot the projectile in the new medium, which diminishes the penetration. As a rule, 12 m. of sand (40 feet) or 10 m. (33 feet) of earth in front of 3 meters (10 feet) of concrete will be sufficient. The Russians demand 9 or 6 sashen (19.2 to 12 m.) according as protection is required against 24 cm (9.5-inch) or 15 cm (6-inch).

The ship fire is stronger in number but generally inferior in effect and duration to a formal land attack, and at present mortar fire has not to be reckoned with. For proper masking therefore, earth taken entirely by itself offers a sufficient cover (especially with shields). But all the other measures to be explained must be taken in the arrangement of the battery, and properly constructed traverses must be employed to limit the explosive effect of shell to a small space, as well as to prevent enfilade and oblique fire. Earth batteries are also cheap both in construction and maintenance, though they occupy more space than armor, especially where disappearing carriages are employed. The height of the battery is very important. This is also important from the point of view of protection, for the ships must remain further off to attain the interior of the works with flat trajectory fire instead of hitting the parapet in the ascending branch of the curve. This standing off at a distance is detrimental to their power and accuracy. With a height of 50 m. (164 feet), the ships must lie off at 2000 m. (2200 yards), with greater height this distance increases, and for 350 to 400 m (1150 to 1300 feet), they must remain at the maximum ranges.*

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* Uncovered perpendicular masonry walls of any sort, sand stone or granite, and in any construction, though once the strongest protection are to-day entirely ruled out on account of fragments and wide embrasures, in connection with the increased accuracy and power of ship's artillery. The striking energy of the 28 cm. (11-inch), 40 caliber, gun is 6543 meter-tons, that of the 30.5 (12-inch), 8629 meter-tons. Todleben already in 1854 could say of Fort Constantine: "These injuries show the imperfection of its construction". At best masonry is only to be suffered in ditch defenses, or in works on small islands, or among high works where the enemy can find no adequate position, or where one's own fire can be superior, as when arranged in tiers. Even to-day a very great expenditure of ammunition might be required to destroy such small, but resisting targets.

Old fortifications may in a similar way be utilized by covering them in front with earth or defilading them. 1 on 9 (7°) is a sufficient protection up to 4000 m. (28 cm, 35 caliber, has an angle of fall of only 6°7′ at 4000 m.).

Yet on the whole the most favorable height will be from 15 to 30 meters (50 to 100 feet), because for this height the danger space will not be too small, and at the same time the ships will have difficulty in elevating their guns. On higher sites the effect of the land guns on armor is diminished, while at heights of 15 to 30 m., the trajectory is still flat and the danger space great, the decks can also be attacked, and the range can be easily estimated. Shrapnel fire and fire from the ships' tops are not much to be feared at this range, and the parapets present very small targets. If there is liberty to choose, therefore, this height should be selected ; 80 meters (262 feet) should never be exceeded. Sites lower than 16 meters (50 feet) suffer from the destructive effect of shell, because the ships can approach nearer and still throw shell into the interior of the works ; especially will this be true of the fire from tops 16 to 20 meters high. When the sea is rough the hulls of the ships are also hard to be seen from low batteries. Of course low batteries are not altogether to be dispensed with ; their peculiar use is to sweep harbors and bays with a low fire having a great danger space.† They are also very effective against ships coming near the shore.

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* With the French 34 cm. gun the trajectory attains the parapet in the ascending branch:

| | | | | | |
|---|---|---|---|---|---|
| Against a | 25 m. | high | battery | at | 1030 m. |
| | 50 m. | " | " | " | 1420 m. |
| | 75 m. | " | " | " | 1690 m. |
| | 100 m. | " | " | " | 1925 m. |
| | 150 m. | " | " | " | 2295 m. |
| | 200 m. | " | " | " | 2600 m. |
| | 300 m. | " | " | " | 3090 m. |

† With the French 34 cm. gun firing against a target 6 m. (20 feet) high the danger space is 258 m. for a range of 1000 m. and a height of battery 0 m ; 124 m. for 25 m ; 82 for 50 m ; 49 m. for 100 m ; 35 m. for 150 m. For a range of 2000 m., 108 m. for a 0 m. height ; 88 m. for 25 m ; 75 for 50 m ; 57 for 100 m, and 56 m. for 150 m.

Against the larger ships that can approach close (say under 1200 m.) the more important batteries should be protected by armor; these batteries should be at least 6 m. (20 feet) above the ship's deck. Disappearing carriages are only practicable for high sites, because they must be protected from bombardment and strong attack.*

With the disappearing carriage as is known, the piece is exposed only at the moment of firing (5 to 6 seconds) to the enemy's sight and to a low angled fire of from 5° to 10°, at medium ranges. After the piece has been fired, it is withdrawn by a special mechanical contrivance to the loading position behind cover. Its chief protection lies in the fact that its position can not be determined by the enemy, and hence a fire against it based on observation is impossible. The protection thus received can be increased by the use of shields to keep out fragments. To hit such a gun can only be accidental. To be sure it is questionable whether a disappearing gun can be relied upon to work properly at the critical moment. The gun emplacement for the disappearing mount is larger than any other and hence a larger target for shell: to counterbalance this, it should be carefully adapted to the locality, in order to scatter the enemy's fire.

Of all existing means of protection, armor, for a given weight and volume, is the strongest and most resisting, on account of its tenacity, firmness, and elasticity. In the least space therefore it furnishes the most complete protection against low angled and high angled fire with armor-piercing projectiles and with common shell. It also allows of a minimum embrasure. In general, however, it furnishes a superfluity of protection, for the ships are not in a position to make the most of the accuracy of their guns. Hence the employment of armor will be exceptional. We must remember too the disadvantage of armor referred to in discussing the efficiency of the guns as effected by the protection.

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* In America the home of this carriage twenty-four kinds of this carriage were constructed between 1866 and 1869 alone. These had dead counterweights, working counterweights, hydraulic, pneumatic and steam power, and finally some that utilized the recoil to attain a side cover. The Houston type was especially cheap; in this, the gun was shot under cover by recoil, turning on a circular track about a pivot to the side. But this took up too much room. The best seems to be one with a counterweight, easily raised and lowered in a well, the carriage rotating on a turn-table over the well. Eighty per cent of all the coast carriages to-day in America are of the disappearing type. England prefers the Armstrong hydro-pneumatic construction The once much esteemed Moncrieff carriage was on the same principle, and also the carriage for the six-inch gun of the well known English Lieutenant-Colonel Clarke, also the Canet mount for the 27 cm. (28 caliber). Durlacher and also Armstrong employs springs to raise the piece. The simplest and most efficient type is the counterweight system in its various forms: the Bethlehem Iron Company, Vickers Sons and Maxim, Crozier-Buffington, Gordan and Morgan, Howell, and last not least Fried. Krupp. Krupp has a cover of 5° to 6°, and a depression of - 5°, which in general is sufficient. The chase is 7.25 calibers long, and the steepest inclination of the piece after recoil is 9°40′.

Armor is employed: 1. To strengthen the carriage as a shield, and to protect the embrasures of casemates and parapets in the older works; 2. An independent form of protection, as an armored casemate or a rotating turret.[*]

Armor is used over center-pivot carriages as a screen sloping upward to the rear with sufficient thickness to keep out shell fragments and shrapnel. The emplacements and parapet are of concrete. The armor thus covers the circular area required for the cannoneers and the ammunition service. In the rear, this cover is either left open or is closed with sheet steel with a sliding door. In front the armor reaches down below the crest of the parapet. This mantle not only serves to keep out shrapnel balls and shell fragments, but also shot from the machine guns.

Armor strengthens the parts of casemates and parapets most exposed to the enemy's fire, and permits a reduction of the size of embrasures.

Armored casemates are independent armored structures, without complicated machinery, and therefore solid and relatively cheap. Sometimes they are placed in connection with one another in series, as in the Gruson cast-iron type, first constructed in 1869 for heavy guns from 21 to 24 cm.[†]

Armored turrets, double-curved, flat arched, rotating, with the upper part of the cylinder protected in front by armor, are the strongest protection known to the arts. Their surface is small and unfavorable to penetration, and by turning the turret after firing, the embrasure is reduced to a minimum, though this has the slight drawback of exposing the long tube of the gun. To protect this also would enhance the price 60 to 70 per cent, which without this is already high. Entirely armored defenses are generally made of cast-iron, whose enormous blocks can withstand the heaviest blows that naval guns can deliver. They are generally built for two guns of 24 cm. to 40 cm. (9.5-inch to 16-inch). A 28 cm. (11-inch) Krupp armored turret can be served by four to six men. A Krupp 30.5 cm. (12-inch) armored turret, including the front armor but not including the gun, weighs 1,390,000 kg., and can resist a 30.5 cm. (12-inch) gun at 2000 m. (2200 yards), *i. e.*, a striking energy of 5000 meter-tons. More recent constructions have been made from nickel steel, and for a single gun, without counting the weight of the gun, weigh only 234,200 kg., a mass however that requires the strongest kind of a foundation. They are arranged for electrical and hand motion. The lighter turrets are generally used for 15 cm. (6-inch) guns, and are now made of nickel steel which considerably reduces the weights.*

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[*] Although iron has always played a weighty role in the history of culture it was reserved for our age to employ it independently in construction.

[†] With the Armstrong disappearing gun England prefers the armored casemate; this is also found in the Gruson form in Germany, Austria, Italy and the Netherlands

The turret is usually placed in a massive concrete structure, with a hollow cylindrical space for the gun, the workroom and the mechanism, which are reached by a gallery.†

The observation stations necessary for observation and fire direction are either fixed or rotating, and are usually armored and connected with the range finder and the guns, by speaking tubes and telephones.

Summing up our remarks on cover, the conclusion cannot be but that while armor is the ideal protection, yet earth cover in suitable positions and properly defiladed is in the majority of cases the most satisfactory, and is the more to be recommended because it favors the action of the gun and is less expensive.‡

As in field warfare, everything must be subordinated to the defense of the terrain. By utilizing the formation of the coast line, sites for batteries are to be withdrawn from sight and direct fire as far as possible, and sometimes even from curved fire. This object can be attained in part by making the target small and by natural and artificial defilading. The line of fire should not be higher than is absolutely necessary for a good field of view and a good field of fire. Cover afforded by the ground is not to be removed unless it interferes with the view of fire. Protection is to be sought from enfilade fire and as far as possible from oblique fire by properly laying out the trace of the works. In order to preserve a good outline and mask the works, traverses should not be carried up higher than the armored shields. Their chief use is to keep out fragments of shell, shrapnel bullets, and machine gun projectiles. With higher batteries they may be omitted or at least made light and open to the rear, but on low sites they must be made strong and closed to the rear. Parados and uncovered masonry are inadmissable, though a cover of 1 on 9 (7°) protects the latter from direct fire. Against indirect fire, cover is necessary for all the apparatus. Disappearing carriages absolutely require high sites and large gun intervals.

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* A shield is often used instead of a turret, giving a carriage that weighs only 5660 kg. For mortars and howitzers, either no armor at all is used, or a dome-shaped shield is used to keep out fragmenets, this being made out of sheet steel, 6 cm. (2.33 inches) thick.

† They are preferred in Germany, Austria, Italy, Holland, Belgium and Russia,—where Todleben for example has joined six cupolas at Fort Miljutin for six 2.75 cm. guns. England has as yet but one cupola on Admiralty Pier, but this is set aside. Porter and Farragut thought much of them.

‡ Earth works have given brilliant examples of their resisting power as at Sebastopol against the French-English attack.

Complete armor protection is only necessary for specially important guns, exposed in position, or subject to capture, or where it is impossible to avoid a rocky background for the battery. The question then must always be decided whether it is necessary to have unconditional security against the most powerful projectiles, or whether light armor will suffice. Where armor is the most suitable protection its use should not be avoided.

After having now considered the question from the point of view of efficient action of the gun and of protection afforded, we will look at the subject from the economical standpoint, and examine the cost. Cost should clearly be adjusted to the end in view. The standard is hard to determine, and much must be left to individual opinion, as to national relations, the character of the coast states, and the amount of wealth. In England hitherto not less than one-third of the guns have been behind armor, whereby two and a half times the value of the guns was consumed in armor. The half of the entire cost for sea and land works thus falls on armor, too great a sacrifice even for a rich country. Even though the price were reduced by improvements in construction, and by no great apparent competition between the iron plants, as in Germany, yet it would doubtless be better to spend a given amount of money for coast fortifications in many guns not so well protected, than in a few for the most part over protected.

As a result of this whole study from technical, tactical, military, historical, and economical standpoints, and taking into view the fact that a concerted attack on coast works is an exceptional condition, I have the following propositions to make.

### I. GENERAL.

Mutual support of the batteries by uniting the guns in groups placed well to the front in the first line, with the mortars withdrawn, at the most important places of the sea front ; not an echeloning of the batteries along the coast. Blocking the enemy in the field of fire of the guns by well defended obstructions, well illuminated at night. For protection the individual targets are to be separated and made as small as is possible, without however separating the guns to a degree that would prejudice fire control and safety ; this separation is most to be recommended with disappearing guns, which yet should be able to concentrate their fire on the field in front. In general, medium sized, low batteries from two to six guns, whose line will stand perpendicular to the main line of fire. The form of the works will be adapted to the ground; entanglements will be used as a protection against landing parties, and sometimes masked cupolas, or wet ditches, or dry ditches and stockades, commanded in reverse. Great attention must be paid to the hydrographic features—anchorages, channels, shallows, currents, flood and ebb, etc., as well as to the back country. Closed works, called coast forts, constructed for an independent defense, will be used only on islands, promotories and the like, or on the wings of sea fronts where defense against land attacks is necessary. They must be equally strong on all sides and have some isolated heavy guns with a fire of 360° in azimuth. They must be constructed to resist land attacks, and regular bombardments from flat trajectory guns and mortars.

### 2. EMPLACEMENTS FOR GUNS.

#### *a. Open earth batteries for center pivot carriages.*

In first line: On high sites, and for low batteries when enfilade or a close approach of the enemy's ships is impossible, and also when only secondary objects are in view.

*In rear lines always.*

To increase the difficulty of silencing the guns, as well as to reduce the smoke cloud, guns in barbette are separated from one another by about 25 to 30 m. (80 to 100 feet) with a training in azimuth of 150°. The bomb proofs and the magazines are in the traverses between the guns or in the flanks. There are no parados.

#### *b. Open earth batteries for disappearing guns.*

In the front line and only on high sites, where there is plenty of room, and for important guns when armor is not essential or not available. The guns, generally under screens, will be at least 50 m. (160 feet) apart to scatter the ships' fire, while they themselves are able to fight in combination. The rooms lie between the gun positions. The wavy vanishing silhouette, and the trees on the inner and outer glacis as a hindrance to view, are the targets to be combated with in time of war.

#### *c. Independent armor.*

For very important isolated guns, especially liable to attack from different quarters, and for which great fighting power, turning capacity, and absolute protection are indispensable. Also for exposed roadsteads, projecting tongues of land, islands, piers, detached coast works (as in colonies), in short, everywhere in which the works and guns are exposed to be surrounded upon the first attack, and also where from the character of the locality it is necessary to make a strong gun position in very limited space, or where it is essential to hold a few costly guns uninjured through a long fight. It will also be used on very low sites, sites with rocky backgrounds, or where ships can approach or enfilade ; it will also serve to give the guns a higer position to escape the ricocheting of hostile shot from the front on the glacis, or to give a protection from shell fragments from the rear, or as a defense against curved fire, and finally—as on the wings of sea fronts—to strengthen the defense against formal attack from powerful landing parties.*

### 3. EMPLACEMENTS FOR HIGH ANGLE FIRE GUNS.

Open positions behind sand or earth embankments, and sometimes under splinter proof screens, the rule. The piece is mounted on simple, rapidly traversed, center-pivot carriage, with the magazines to the side. At times four mortars to an emplacement, the detached well-shaped mortar emplacements being connected with one another and with the magazines and range finders by galleries.

Armor in very exceptional cases, as when howitzers are to be used for direct fire like guns, against ships near by. Gruson's Kugelmörser† are unnecessarily strong, and since they are not constructed for direct fire they may be put out of action by a chance shot striking the observation station.

*Ceterum censeo :* Open batteries the rule for the mass of the guns. Economy is well for both the artillery and the navy.

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* Sometimes the advantages of both constructions can be united by placing earth walls about low armored structures.

† A species of armor made by the Gruson works, the mortar being protected by a dome shaped armor.—Translator.

# REAR SIGHT WITH CROSS LEVEL AND TELESCOPIC SIGHT FOR FIELD GUNS AND FIELD HOWITZERS.*

BY CAPTAIN A. E. PIORKOWSKI, IMPERIAL GERMAN ARMY.

The efficiency of field guns on the battle field depends, to a high degree, on the sighting apparatus. Neither the firing itself nor its rapidity secures success, but it is dependent entirely on its accuracy and the number of *hits;* for this, correct sighting and laying the guns is accountable. Truism as this may appear, it needs an explanation as to what correct sighting consists of. It might briefly be said that the sighting apparatus must be adapted to the gun, *i. e.*, it ought to be so designed as to bring out the full effect of which the gun is capable.

From a merely technical standpoint, modern guns are precision instruments, their sighting apparatus should be of the same character. Until quite recently this requirement has not been satisfied. Rifled guns for a long time have been capable of an accuracy far superior to that of smooth bores, and have developed into precision arms. Nevertheless they were still provided with the sights inherited from the smooth bores, having only the addition of a lateral movement for drift and deviations.

Besides those errors in aiming which result from poor light, difficult recognition and observation of the target, etc., there are other sources of error in the eye of the gunner himself, and in the possibility of aiming by "full" or "fine sight," instead of "half sight." This source of error, often of great influence, is practically uncontrollable.

All these possible causes for poor aiming are reduced to a minimum, if not entirely eliminated, by attaching a spirit level to the rear sight.

Krupp's field guns and howitzers exhibited at the Düsseldorf Exposition 1902 showed rear sights with level in several designs, made in Krupp's workshops. They all follow the same principle of construction and only vary according to the place where the level is attached and the manner of moving it. Since 1898 Krupp provides rear sights with level for all his field guns.

### 1.—REAR SIGHT WITH LEVEL AT THE HEAD OF THE SIGHT STEM.

(Figures 1 to 9.)

This construction was in use with Krupp's short recoil (elastic spade) guns to the end of the nineties. The gun carries the housing (A) of the sight on the upper right hand edge of the breech; the sight stem moves in the housing, and both are curved in an arc having the point of the front sight as center.

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* From the German, *Libellenaufsatz und Fernrohraufsatz für Feldgeschütze.* Berlin: E. S. Mittler und Sohn. 1903.

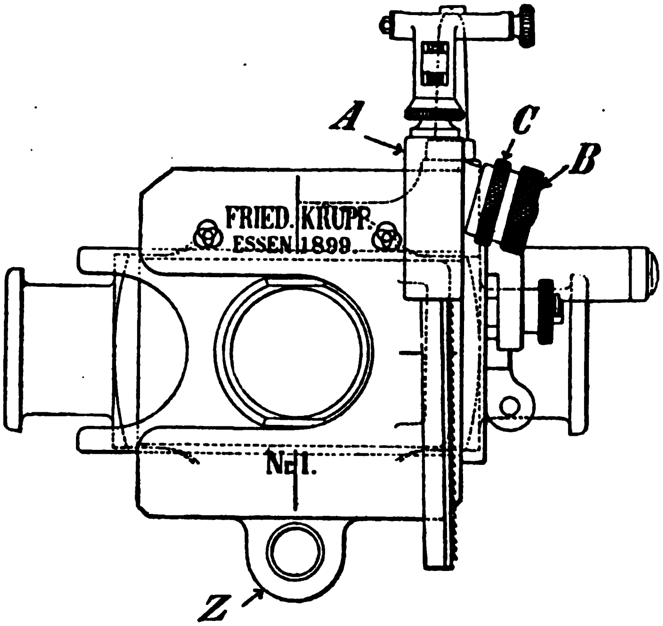


Fig. 1. Rear sight with level. On breech. View from rear.

The front sight is on the right trunnion. The sight stem and its guides are inclined, so that the correction for drift is given automatically, at all ranges. Therefore, as long as special conditions do not necessitate an extra derivation no lateral correction is required. In case wind or other conditions make such a correction necessary it is done by turning the milled head as seen in the upper right corner of fig. 5. Thereby the open sight moves along a scale, divided into 40 parts, each part equivalent to one thousandth of the length of the line of sight, which is one meter. The middle of this scale, at part 20, indicates the normal. By this arrangement the necessity of the command "right" or "left" is avoided; the zero mark in the middle, with numbers running both ways, would easily lead into errors.

When the elevation is given on the sight stem, the level will move with it, and when the breech of the gun has been raised or lowered according to the required elevation, the bubble will center.

The sight stem carries the scale for ranges on its rear convex edge, and next to it a rack, gearing with a worm, lodged in a box at the right side of the sight housing in an inclined position. By turning the milled head B (figs. 1 and 2) the worm gear will raise or lower the sight. To save time, in case of considerable

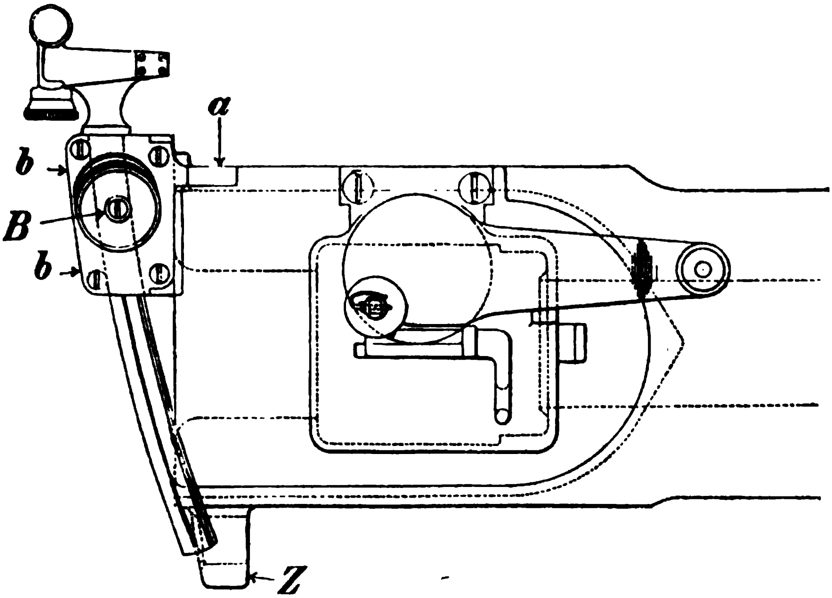


Fig. 2. Rear sight with level. On breech. View from right.

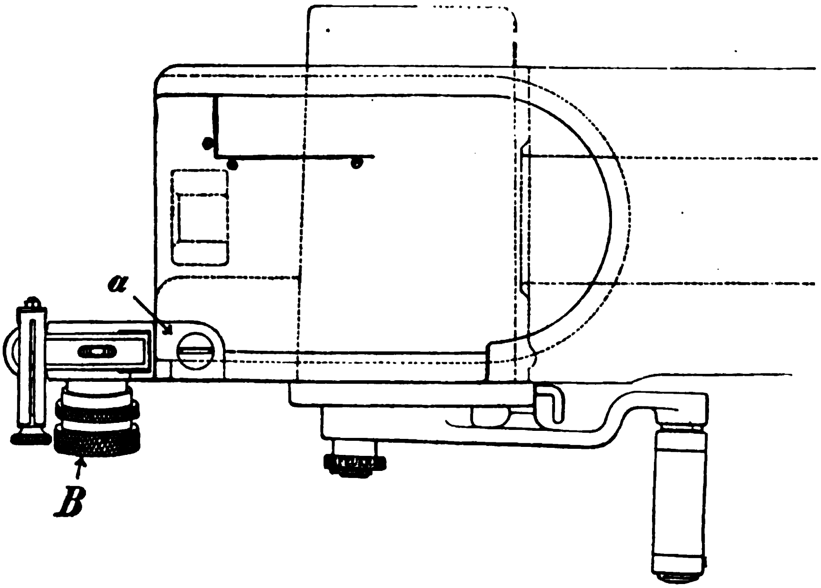


Fig. 3. Rear sight with level. On breech. View from above.

change in elevation, the worm can be thrown out of gear by turning the milled nut C (fig. 1) and the sight stem then can be moved direct by hand. By turning the nut the other way the worm is thrown into gear again. The upper rear edge of of the sight housing is beveled for the elevation scale placed thereon.

The level and open sight are on the head of the sight stem (figs. 4 and 5). The level housing N which encloses the level can swing up and down round shaft O; its rear end is linked by a pin M with the nut L; in L, the screw K moves up or down taking the level with it by turning the milled head G. In this way the bubble is centered when the position angle is measured; whenever the target is in a position higher or lower than that of the gun, the bubble will be centered by turning milled head G.

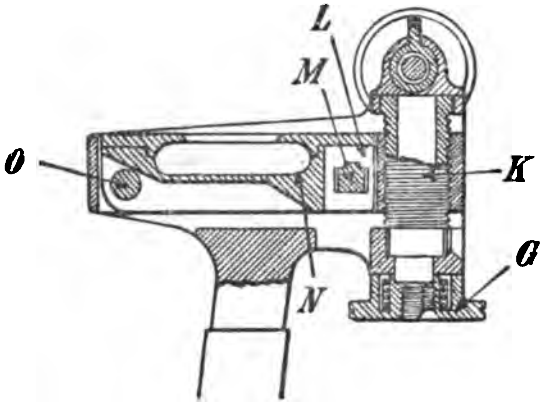


Fig. 4. Rear sight with level. Level and sighting mechanism. Vertical longitudinal section viewed from left.

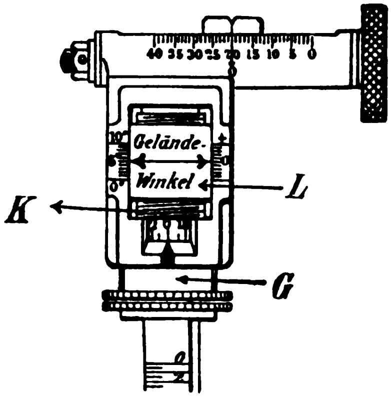


Fig. 5. Rear sight with level. Sight head. View from rear.

The nut L, on its rear side, carries an index (fig. 5) for the scale of the position angle marked on the sight head. The scale is divided into ten degrees from 0° to 10°, 5° being the normal, with angles of rising ground shown above angles of falling ground below. Every full turn of screw K corresponding to one degree, a division into twentieths on its circumference and an index on the sight head allow the reading of twentieths of degrees.

If the firing is continued without change of elevation, the gun needs only to be raised or lowered to center the bubble.

If the elevation is to be changed, no new aiming is required; it suffices to give the sight stem the new elevation, and again raise or lower the gun until the bubble is centered.

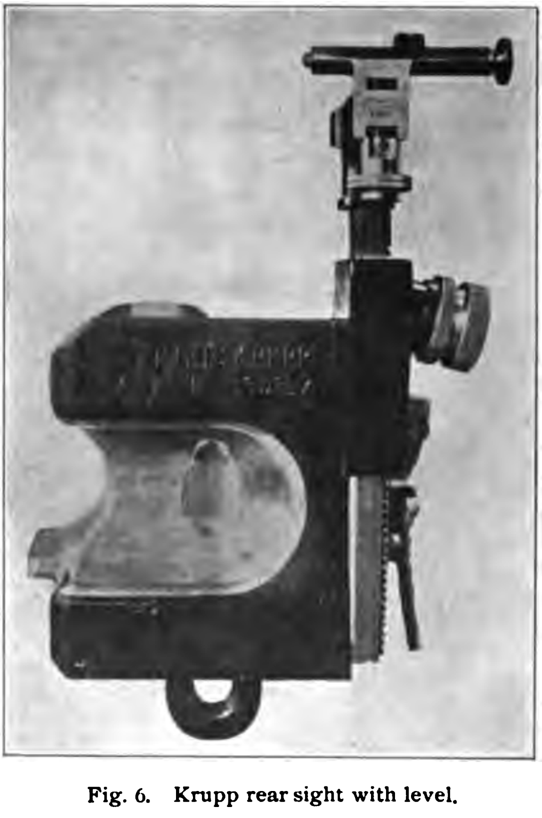


Fig. 6. Krupp rear sight with level.

## 2.—REAR SIGHT WITH LEVEL ON THE SIDE OF THE SIGHT STEM.

(Figures 10 and 11.)

For long recoil guns, a modification of the position and design of the sight with level was necessary. The rear sight had to be transferred to the left of the gun, and attached to the cradle to allow aiming to be done independently of loading. The gunner occupies a seat at the left flask, and remains seated whilst aiming. To allow him to observe the level without getting up, it had to be attached to the outer side of the sight stem at about the middle. This design of the rear sight has been made by Krupp, since 1900.

To make the timing of the fuses agree with the range, the correction so-called by "spaces" was adopted. For this purpose, the sight stem was made double, an inner steel sight stem moving in grooves in a hollow outer bronze sight stem ; the relative position of inner and outer stem can only be changed by means of a pinion for space correction, which will be explained below. On top of the inner stem is the sight piece, and in about its middle the level box is attached by screws.

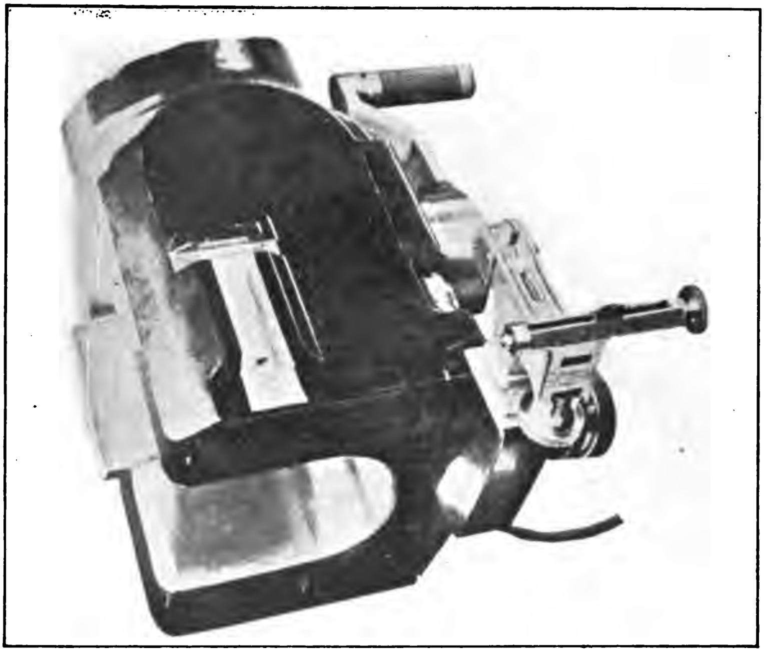


Fig. 7. Krupp rear sight with level.

With short recoil guns, this kind of rear sight with level, as well as the one previously described, moves in a box at the right side upper corner of the breech. With long recoil guns the sight box is placed on a bracket fastened to the left side of the cradle. In all other respects the construction and use of the sights for the two kinds of guns is the same.

These sights have an attachment to eliminate the influence of wheels not being on the same level. The sight box can be oscillated round a shaft (fig. 16) and swings along a graduated arc on the bracket. A level is fixed on the sight box, at right angles with the axial vertical plane, and its bubble will center at zero if the wheels are horizontal. If not, a worm gear with milled head serves to adjust it; as soon as the bubble is centered the stem will have the correct inclination for drift. The graduation runs 5° to the right and left of zero and an index shows the angle of the sloping wheels.

The outer sight stem (figs. 8 and 9) is curved and has a similar scale and rack as described above for the sight with level on top; it is moved up and down in a similar way by worm gear and milled head; only the manner of throwing the worm out of gear has been simplified; it is only necessary to turn a small lever to release the worm and allow the sight to be raised or lowered by hand.

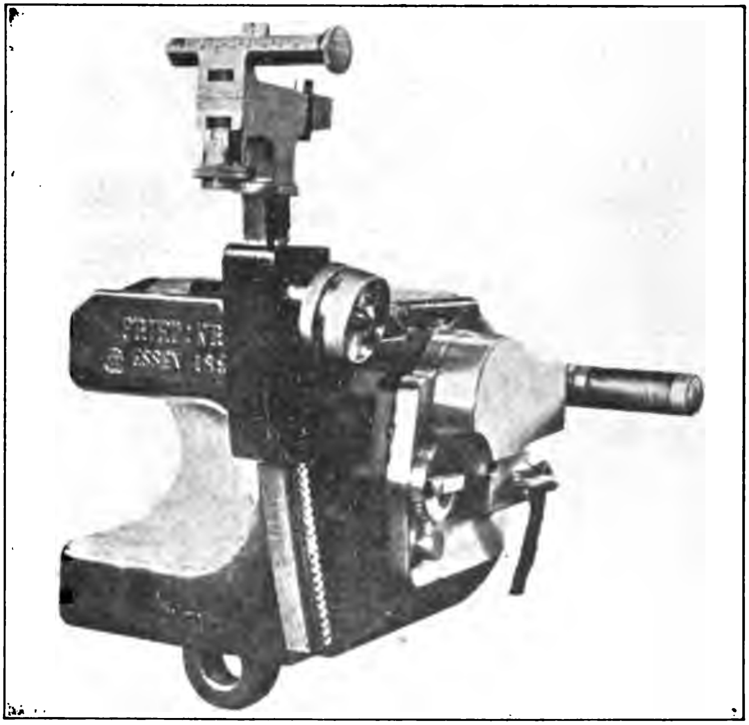


Fig. 8. Krupp rear sight with level.

The inner sight stem carries the sight piece which forms a cylindrical frame guiding the slide with the open sight and holding both ends of the slide screw, for the lateral movement of the notch. When the screw is turned by its button-shaped milled head, the notch protruding through an upper slit in the frame, moves along the derivation scale, which beginning with zero at the right, is divided into 60 parts, the normal position being 30, so as to count the derivation in one sense only.

The box of the level for measuring position angles is fixed on the left side of the inner sight stem. The level housing swings round a shaft at its front end, when its rear end is moved up or down by a screw with milled head. In the level box is a steel drum with a scale of 16 degrees, counting from 0° to 16°, with 8° indicating the normal; at the upper end of the screw, the pitch of which is equal to 1 degree, is a disc divided into 20 parts (fig. 13) to measure twentieths of degrees.

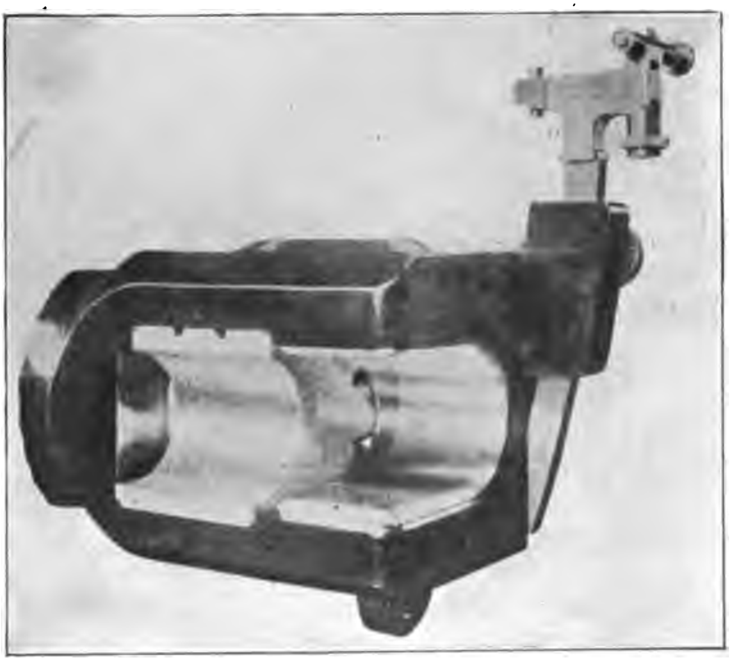


Fig. 9. Krupp rear sight with level.

To correct the bursting height of shrapnel ("space" correction) the inner sight stem is moved in the outer one by turning the wing-screw visible below the sighting piece in fig. 10. For this purpose the inner stem, on its concave front edge, has a rack gearing with a pinion which turns with the wing-screw. Each half turn moves the inner stem with the sighting head one space

—about $\frac{3}{16}$ degree—up or down, without changing the position of the outer stem and the range for which it is set. Every half turn of the pinion is marked by the click of a spring engaging between its teeth and the number of half turns or spaces can be read from a scale on the inner stem, where the word "Spaces" is engraved. The scale reaches 6 spaces up and down.

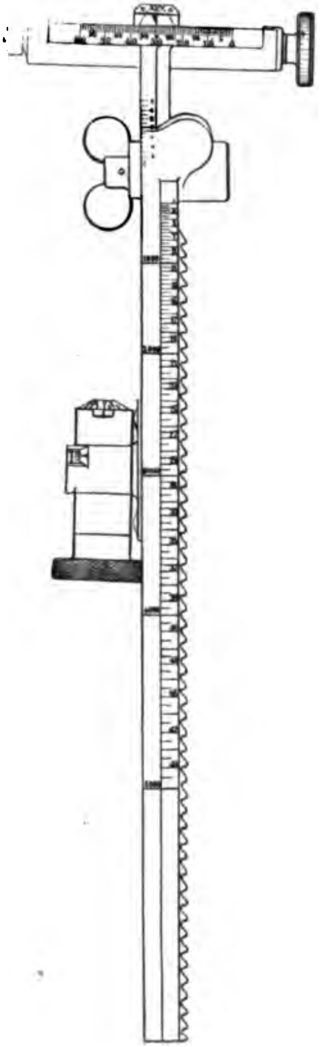


Fig. 11.

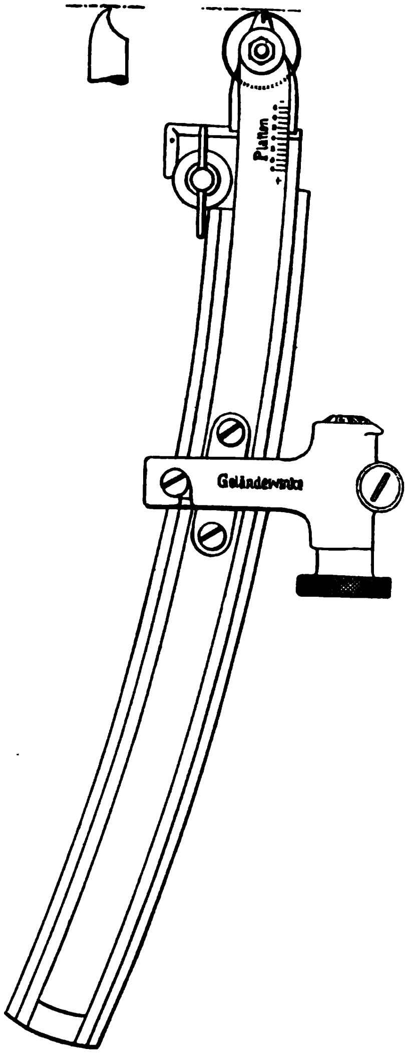


Fig. 10.

Krupp rear sight with level. Level on the sight stem.

The advantages derived from the use of the sights with level instead of the old sights, although evident from the above descriptions, may be summed up again:

1st. As soon as the position angle has been determined by the first direct aiming at the target, and eliminated by setting the level, it is only necessary for all subsequent aiming at the same target, to give the gun that elevation at which the bubble is centered.

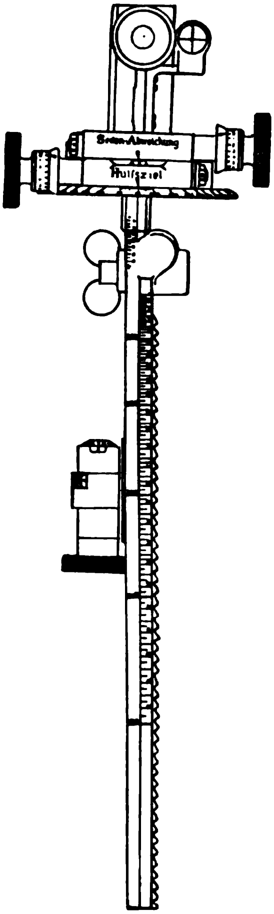
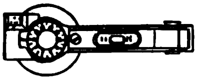


Fig. 15.

Bild 13.



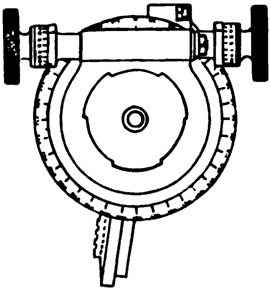


Bild 14.

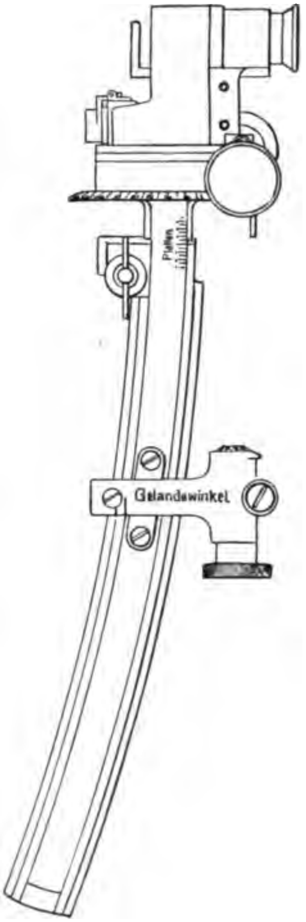


Fig. 12.

Krupp telescopic sight.

2d. The position of the level of one gun can at once be taken up by all other guns standing at the same height and firing at the same target. This makes the control of the elevation of all guns in a battery easy. Differences in the position of the level, which the chief of piece can see from his place even during rapid firing, will point out all errors to him.

3d. This easy and reliable control of the aiming is especially important when the target is not distinctly visible; aiming then is difficult, as also towards covered positions, and this method of control will be the rule in the future.

4th. The simple use of the sight with level facilitates the instruction of gunners.

5th. The sight with level takes the place of the quadrant in indirect aiming or at night.

### 3.—TELESCOPIC SIGHT FOR FIELD GUNS AND HOWITZERS.

(Figures 12 to 19).

Progressing improvement of fire-arms has increased their range and effect of projectiles. This leads to covered positions being taken as a necessity. Aiming at covered targets grew more difficult with the use of smokeless powder, because lacking observation of the enemy's fire, it became difficult to discover his posi-

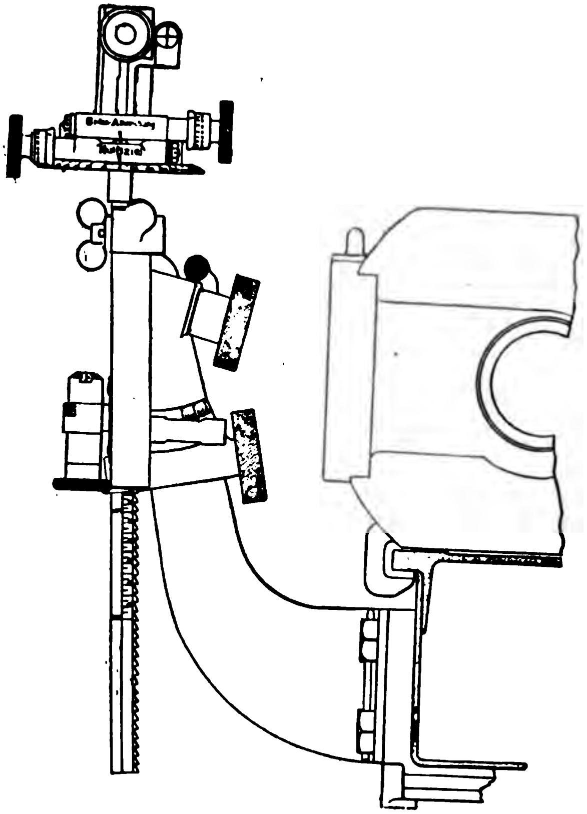


Fig. 16. Krupp telescopic sight. Fixed on recoiling-gun carriage.

tion and keep it in sight; thus aiming by open sight has lost some of its accuracy. On the other hand, the advantages of a rear sight with level depend on a first accurate aiming over the open sights and centering the bubble accordingly. Therefore it is an important development to replace the open sights by a telescope. The telescope makes observation of the target easier, and by enlarging, makes aiming more accurate.

The optical axis takes the part of the sight line and allows aiming without a front sight; this, with gun carriage shields, is an advantage, in reducing the necessary opening without limiting the field of view.

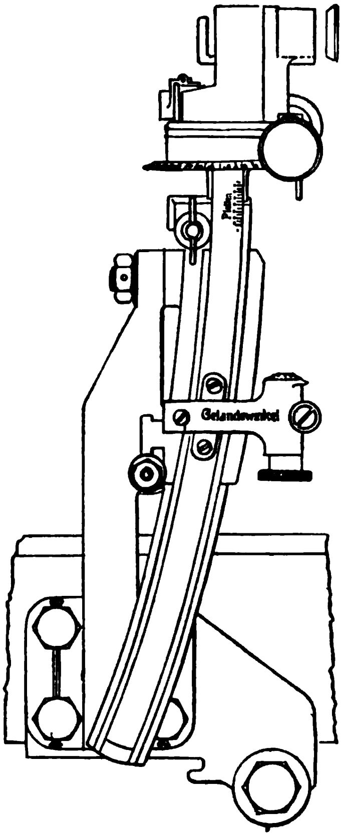


Fig. 17. Krupp telescopic sight. Fixed on recoiling-gun carriage.

Direct aiming at covered positions is often impossible and using an auxiliary line becomes necessary. The old methods of obtaining an auxiliary line failed. So an azimuth disc was added to the telescope dispensing with artificial auxiliary lines.

A telescopic sight with its azimuth disc (figs. 12 to 15) is similar in design (excepting the sight head) to a sight with level attached to the side of the stem; so the description of these parts need not be repeated.

A short prismatic telescope with cross lines is used. The latter form a St. Andrew's cross with vertical lines above and below for very high or very low auxiliary lines. At night the cross lines can be lighted up by a lantern from the side, and made distinctly visible.

As the stem is inclined for drift, the telescope moves, as the range is given, through an angle corresponding to the drift.

If an extra deviation has to be given, the pinion, marked "lateral deviation" is turned by its milled head, and the angle of deviation is read on the drum by degrees and twentieths of degrees. The pinion has a scale of 10 degrees.

The enlargement by the telescope diminishes its field, which is a disadvantage in aiming at moving targets. For a quick perception of the target, a "finder" is combined with the telescope in the same housing. (Figs. 18 and 19). The "finder" has an optical arrangement by which the cross lines which are transparent in opaque glass plate, are reflected into the gunner's eye. In looking at a distant target the cross lines appear as if at the same distance.

This apparent coincidence of the cross lines and the real target—different from the appearance in a telescope where the cross lines coincide with the image of the target—makes an accurate, quick and easy aiming at distant targets possible without any focussing. No substantial cross lines could be used, because there are no lenses, and cross lines without a point of sight in front, gives no line of sight.

The "finder" has a field of 20 degrees. Eye piece and objective opening are protected against dust by glass plates. In case the target is very bright, there is a smoked brown glass plate at the objective opening to make the cross lines more visible. At night, the cross lines are lighted up by an artificial light and the polished interior surface of the protecting cover acts as a concave mirror.

In place of the "finder" an auxiliary sight may be used consisting of a short alidade with two pairs of cross lines mounted in rings (fig. 12) on the right of the telescope, its line of sight parallel to the optical axis of the telescope. Two buttons on the gun itself form a sighting line parallel to the bore and serve to give approximate direction while unlimbering the gun.

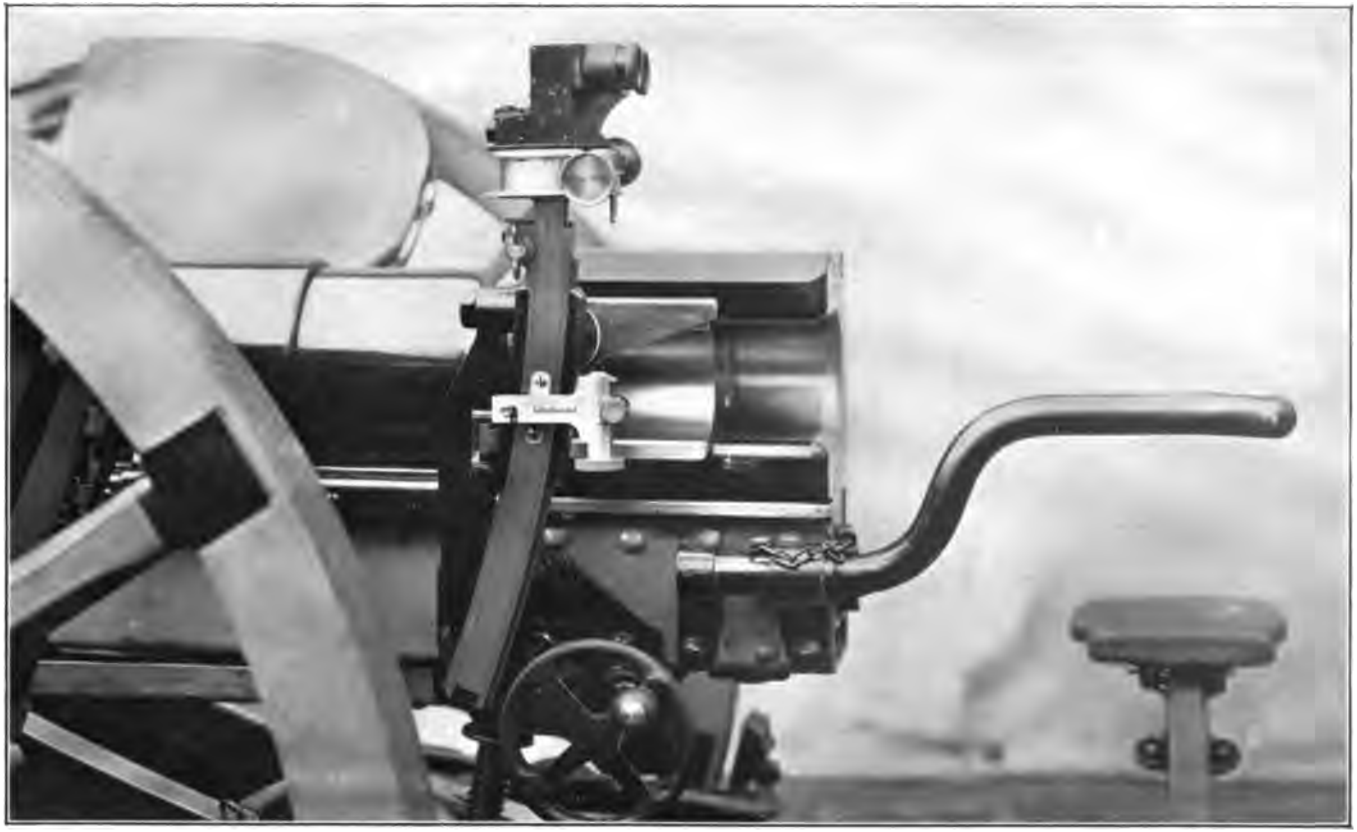


Fig. 18. – Krupp telescopic sight on recoiling-gun carriage. – View from left side.

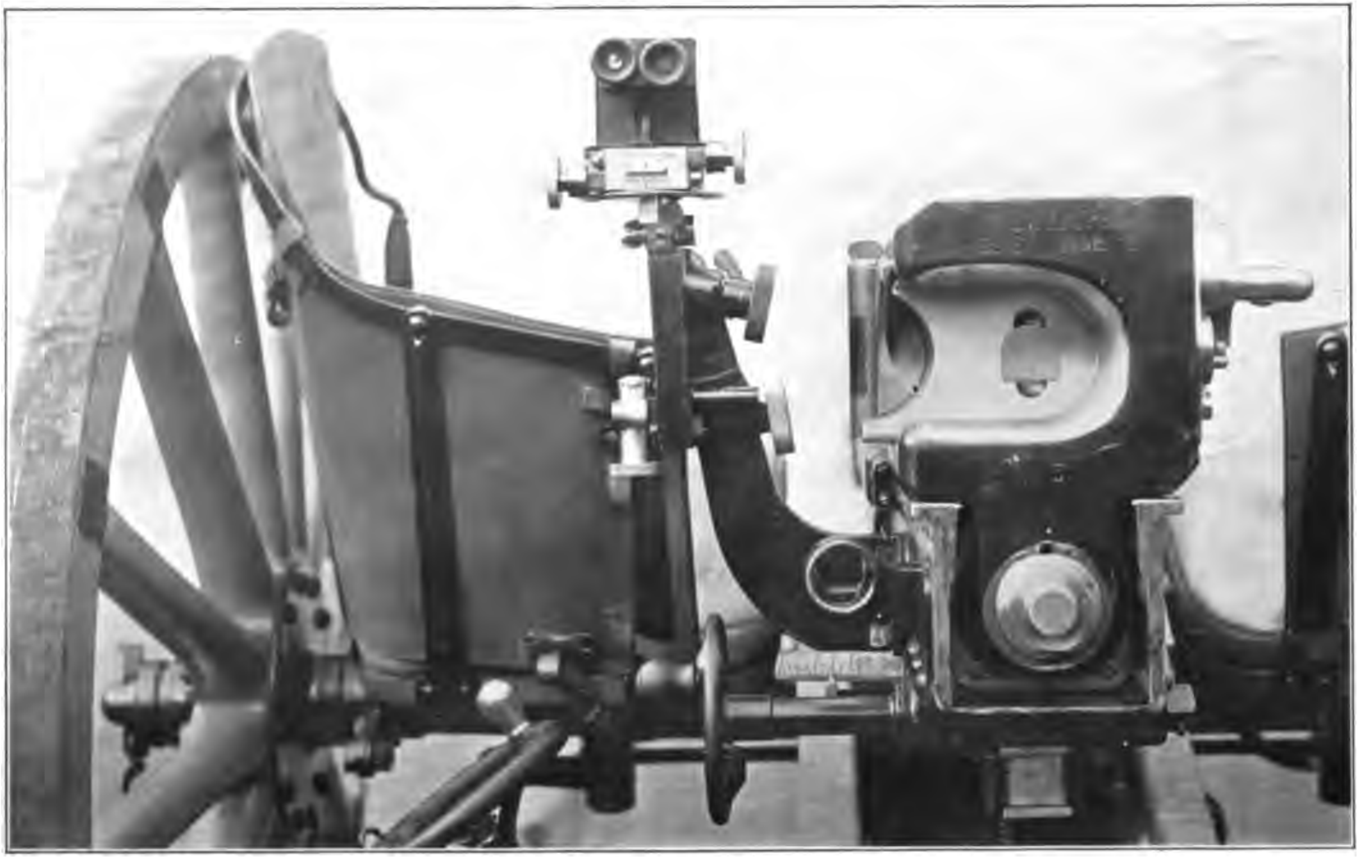


Fig. 19.- Krupp telescopic sight on recoiling-gun carriage. View from rear.

In case the telescope is also intended for use as a hand telescope it is designed to be put on or taken from the gun, and has a dovetailed base piece fitting in grooves on the azimuth disc.

The azimuth disc (fig. 13) serves for aiming on an auxiliary line, and the telescope can be turned in any direction across it. The azimuth is divided into 360 degrees numbered from 10 to 10. A pinion marked "auxiliary line" (fig. 12) moves the telescope around for any desired angle and has near its milled head a scale of twentieths of degrees. To move the telescope quickly for a large angle the pinion can be thrown out of gear by pressing a button under the azimuth disc, so the telescope can be moved by hand freely.

This arrangement of the telescope on the azimuth disc would force the gunner to follow the movement of the eye piece which would make aiming on a lateral sight line difficult. To obviate this, a recent design allows the optical axis of the telescope to move while the eye piece remains stationary; in this way the gunner can take aim in any lateral direction without changing his place.

Krupp's experiments with telescopic sights date from 1894, but the technical difficulties were only overcome since 1899. The main difficulties arose from the task to maintain the correct position of the optical axis in spite of the vibrations caused by firing and transporting the gun. Success in this direction was only reached one year later, in 1900, when the terrestrial telescope used until then was replaced by a Porro prismatic telescope; this is so short that it is supported for its whole length on the sight head (fig. 17).

Many such telescopic sights have been made since 1901 in Krupp's workshops, as their advantages were readily acknowledged.

It ought to be well understood, that the impression of a certain complication, conveyed by the above description, is not realized in the actual use of the telescopic sight with azimuth disc. Although admitting that its construction is more complex than that of older rear-sights, it undoubtedly works very much better and enables the entire efficiency of the gun to be secured; this was not the case formerly—adding a new instance to the old experience that, where human dexterity fails to fulfill requirements as to the effect of fire arms, mechanical means must come to the rescue and man must compromise with their complications in order to reach his ends.

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# THE PROPER EQUIPMENT OF A MOUNTAIN BATTERY.

COMMUNICATED BY THE CHIEF OF ARTILLERY, U. S. A.

Battalion Field Artillery,
Fort Leavenworth, Kansas,
*February 27, 1903.*

Chief of Artilllery,
U. S. Army,
Washington, D. C.

Sir:

I have the honor to transmit herewith reports from Captains George W. Van Deusen and Charles T. Menoher, Artillery Corps, on the equipment furnished mountain batteries in our service, to which your attention is respectfully invited. In connection with these reports I would state that, from my own observation, both before the Mountain Battery (28th) undertook its march to Fort Riley, as also during that march which was made under my supervision, and the subsequent work during the maneuvers at Fort Riley, I am convinced that the faults mentioned by Captain Menoher in his reports are well founded, and that I fully concur in the conclusions arrived at by him. Copy of report of Captain F. E. Johnston is also enclosed.

H. M. ANDREWS,
Major, Artillery Corps,
Commanding Battalion, F. A

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Fort Leavenworth, Kansas,
*April 16, 1902.*

Major H. M. Andrews,
Commanding Field Artillery Battalion,
Fort Leavenworth, Kansas.

Sir:

In reply to letter from the Office of the Chief of Artillery dated April 10th, 1902, enclosing a report from Captain F. E. Johnston, Artillery Corps, regarding the pack outfit of the Maxim-Nordenfeldt 75 mm. mountain gun, and requesting my opinion regarding the matter, I would state that my views as to this gun and pack outfit were given in my report to the Adjutant General, U. S. Army, dated April 23, 1900. As I have had no practical experience with these guns since making this report, I have no reason for changing the opinions expressed therein. So far as I can ascertain from Captain Johnston's report his only experience with these guns in the field was during a parade in Manila, and on the strength of this he unreservedly condemns an equipment which has stood the test of service in the Soudan and in the Philippines. I have had some little experience with aparejos and pack saddles while in the cavalry, and in my opinion the Maxim-Nordenfeldt pack outfit is the best I have ever seen. No pack saddle can be constructed perfect enough to preclude necessity for occasional re-adjustment of the packs, and I do not believe the most expert packer would expect to take his train through a day's march without occasional stops for this purpose. In my opinion the test given this outfit during the campaign of General Schwan's expeditionary brigade in Southern Luzon in January and February, 1900, was about as severe as could as possibly be given, especially with one gun, which was packed all the time and accompanied me, not only with the marches of the main body, but on numerous side trips. I started on this expedition with green mules, and men who had received no drill or instruction in packing. On several occasions mules fell into streams, were fished out, repacked with the saddles thoroughly wet and continued the march. The country was of the roughest kind and level ground was a rarity. Yet I never had a mule disabled from any cause, and brought them to the end of the campaign at Santa Cruz de Laguna without having had a sore back or anything of the nature. This was especially remarkable as during a large portion of the time the animals were living off the country and had no forage save what we could find, principally rice and often very little of that. After the men and mules became accustomed to the work there was very little trouble with the packs and very little time spent in re-adjusting them. The trail was the only pack which gave any trouble and I suggested that it might be well to have a special saddle made for this so that the rear part of the trail would be raised higher and so do away with the danger of the spade hitting the mule's tail. I also suggested substituting hair for cord cinches and lashings for buckles. But I consider that the pack outfit as a whole is decidedly serviceable. Captain Johnston's entire field service seems to have been with the Hotchkiss pack outfit, and because this did not work well, he condemns all existing systems. For further details I would respectfully refer to my report of April 23, 1900, which was published in the *Army and Navy Register* of

May 19, 1900, and also in the *Journal of the U. S. Artillery* for July and August, 1900.

Very respectfully,
Geo. W. Van Deusen,
Captain, Artillery Corps.

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Fort Leavenworth, Kansas,
*January 20, 1903.*

The
Chief of Artillery, U. S. A.,
Washington, D. C.

Sir:

Referring to report of Captain F. E. Johnston, Artillery Corps, of November 12th, 1901, relative to the equipment of the mountain batteries in our service, copy of which report accompanied letter from your office of April 10th, 1902, I have the honor to submit the following report based on actual experience with the equipment in question during the recent march from this post to Fort Riley and return, and during the maneuvers held at that post.

While it was believed at the time of the receipt of Captain Johnston's report that his views were probably correct in most particulars, yet it was thought that he had not given the equipment a fair practical trial, and this report has purposely been delayed in order that an opportunity might be had to test the equipment thoroughly before reporting adversely.

During the months of September and October, 1902, this battery marched in the neighborhood of four hundred miles, all the distance, with the exception of about fifty miles, being covered with the guns, etc., packed—the latter distance being covered in draft.

Long before the march to Fort Riley was undertaken, it was found absolutely necessary to discard the straps with buckles intended for securing the cinchas and to replace them with rawhide cincha straps, such as are used on the McClellan saddle.

With the above exception, and one or two minor changes in the method of securing the loads to the saddle, the battery made the march from Fort Leavenworth to Fort Riley with the saddle equipment as furnished.

Great trouble was experienced during the march in keeping the loads in place and in keeping the saddles from turning. If the cinchas were made tight enough to properly secure the saddle, the mules were certain to come into camp at the end of the day's march with great cincha galls on their bellies.

Some two or three months before the battery undertook the march to Fort Riley, requisition had been made for a sufficient number of "Aparejo" cinchas to equip each saddle with one, and the gun, cradle and trail saddles with two. These arrived just after the battery reached Fort Riley. The small cinchas supplied with the pack-saddle were discarded and the saddles secured by means of the canvas cinchas in exactly the same manner as the "Aparejo". With the gun, trail and cradle loads, a second, but longer, canvas cincha was used to enclose load and all and fasten in the same way. The wheel and axle loads were secured by a special rope lashing, the wheel hangers being held down in place by one of the small hair cinchas. The ammunition hangers were secured as originally, by two small hair cinchas.

The arrangement just described was found to work 100 per cent better than the original arrangement of securing the saddles and their loads, and to reduce the time of saddling and packing about one-half.

One of the greatest troubles found with the saddle was the constant chafing of the mules' backs. This was reduced somewhat by the use of the canvas cincha, but not obviated by any means.

The saddle I consider faulty in every particular. In fact its only redeeming features are that it is made fairly well and looks well in a photograph.

The body of the saddle is entirely too small to get sufficient bearing surface on the back and sides of the mule, and besides, has no stiffness, nor stability. The side bars are too short, and are so curved in the direction of the length that the load rocks "fore-and-aft" like a hobby horse. This rocking motion is so great with the trail loads, that the up and down motion of the end of the trail is, in the case of a mule with a long swinging gait, anywhere from six to ten, and even twelve inches. Only some five or six of the mules belonging to the battery were found, with a gait short enough to carry this load with any kind of ease, so great was the pounding of the end of the trail on the mules' rumps. The frame of the saddle is entirely too short, the points of support being just twelve inches apart.

When it is borne in mind that the trail is five feet long, is resting on two points of support only twelve inches apart, and that its center of gravity is some twelve inches above the mule's back, some idea may be gained as to the stability, or rather instability, of the load. The same remarks apply, except in a lesser degree, to the other loads. As stated above some fifty miles were covered in draft. This was done with the idea of making a comparison between the two methods of transportation. The result is, to my mind, all in favor of packing even with poor saddles on hand.

The small wheels rendered necessary for packing, make the draft entirely too difficult to be used except in rare cases, and for short distances only. The breast strap of the saddle was found to be attached so as to cut off the mule's wind to a great extent, and, of course, to tire it out in a short time.

The idea does not seem to be generally grasped that a mountain battery, as its name implies, is intended for use in the mountains, that it is an outfit primarily intended to be transported by pack mules. In other words, that it is intended, or should be intended, for service where wheel transportation cannot go. The fact that in most foreign services, particularly the British, the method in draft is used whenever practicable, is no argument in favor of that method of transportation. It shows that their pack-saddle is not practicable and is used only when the method in draft cannot be employed.

The shafts supplied with the Vickers-Maxim outfit are one of the most difficult parts of the equipment to pack satisfactorily, and besides are too weak to stand travel on any except very good roads.

Attention is invited to the following comments made by Major M. M. Macomb, Artillery Corps, one of the umpires during the recent maneuvers at Fort Riley, on the proper role of a mountain battery.

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"In regard to the employment of a mountain battery together with field batteries, some comment should be made, in order that no mistake should arise as to the propriety of doing so in actual war. As a matter of fact, their roles are entirely different; one is suitable to open country like this reservation, and the other to mountain regions, where wheeled vehicles cannot go, and where transportation must be by pack animals. * * *

"In a close country with steep mountain trails unsuitable for wheeled vehicles, and where only pack transportation can be used, the mountain battery finds its true function. It is a mistake also to attempt to use draft for these guns. As a matter of fact this can only be done over the main roads, like those about this post or from here to Junction City, in good weather. It is poor policy to try to drag the gun over heavy roads, as under these circumstances it becomes a 'mule killer'. Hence it hardly seems worth while to pack along the unwieldy shafts for the sake of drawing the gun for a short distance over a macadamized road. In other words, the shafts are an unnecessary encumbrance for an American mountain battery, and the commander did well to leave them in camp.

"A mountain battery should never be placed in a battalion with a light battery, as under no circumstances can the commanding officer of the light batteries handle it with them, due to its entirely distinct and special role, and the fact that it would be an encumbrance to the rapid handling of his command."

The felt saddle pads supplied with the V. M. saddle are not of much use. When the mule's back becomes chafed, the felt absorbs the blood and moisture incident to the chafing, soon becomes hard, and in a little while is worse than useless. Felt, I believe to be a good material for such purposes, but it should be lined with cotton duck and should be bound well with leather to keep it from being pulled out of shape.

The gun and carriage were found to work satisfactorily in every way when fired, but the trail can hardly be more awkwardly constructed for packing purposes. The elevating mechanism is needlessly heavy and should be constructed on different principles. The trail itself should be jointed so that two side packs could be made instead of one top pack.

My conclusions are therefore as follows:

1. The Vickers-Maxim pack-saddle with which the mountain batteries in our service are equipped, is a failure.

2. The trail of the Vickers-Maxim mountain gun, while working very satisfactorily in firing is entirely impracticable for packing.

3. The idea of transporting mountain guns in draft should be discarded and the shafts dispensed with as a cumbersome and unnecessary appendage.

The recommendations of Captain Johnston, as to the proper saddle for mountain batteries, are good, and some such combination as he suggests will probably give the most satisfactory results, although the details of the proper combination of the saddle tree and aparejo will necessarily have to be a matter of thorough trial.

The undersigned has under consideration at present the details of a pack-saddle for mountain guns. An experimental saddle is being made at present and will be given a trial in the near future. The details of the saddle, if a success, will be made the subject of a subsequent report.

Very respectfully,
CHARLES T. MENOHER,
Captain, Artillery Corys,
Commanding 28th Battery, Field Artillery.

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Nagasaki, Japan,
*November 12, 1901.*

The Chief of Artillery,
Washington, D. C.

Sir:

In the interest of the Artillery service, I have the honor to submit the following remarks and observations on the equipment of the mountain batteries in the Philippines.

At present there are two mountain batteries in the Philippine Islands, both of them organized since August last. When I left Manila November 7, 1901, only the 14th Field Battery had pack animals, and even it did not have half the necessary number.

But even with the full complement of pack animals these batteries cannot be regarded as being serviceable; for the reason that the pack saddles are impracticable and can never be modified so as to serve efficiently the purpose intended.

None of the officers with whom I have discussed the subject of pack saddles for mountain guns seem to have a clear conception of the requirements of such saddles. Even officers serving with mountain batteries in the Philippines at present freely admit that the pack for the Vickers-Maxim 75 mm. M.G. is impracticable but for want of experience in that particular line, they are not prepared to suggest a remedy.

During a parade of the Manila troops, about November 1st, I was in command of the 14th Field Battery, which is equipped with the Vickers-Maxim gun, and found that even on the level streets of Manila it was impossible to keep the guns packed on the pack animals. Knowing from experience at drill what I could reasonably expect, I kept the guns, mounted on their carriages until the first halt of the column when I packed the guns and carriages.

The battery had moved less than half a mile before several delays were experienced so much so that it was necessary to unpack the battery and mount the guns on their carriages.

It can readily be seen how proficient such an equipment would be in the field.

This gun was used by General Funston's command; and in discussing with the General its value, he told me that he had it packed on aparejos to which Vickers-Maxim saddle frames, after modification, had been attached. I afterwards saw these packs at the Manila Arsenal. While serving temporary purpose, it was far from satisfactory and could not be adopted for permanent use.

It would seem that the very name "Maxim" would recommend the Vickers-Maxim 75 mm. gun; but as a complete outfit it is a sad failure. The principle of the gun is good; the breech mechanism fine; the recoil system admirable; but the trail is a heavy and clumsy construction that would not do credit to an apprentice boy in a machine shop.

The elevating apparatus which forms part of the trail is very heavy and its construction makes the assembling of the cradle to the trail very difficult, to say nothing of valuable time lost.

As for the pack saddles they have not one redeeming feature to recommend them. The pads are soft and mushy; the girths are narrow and inefficient despite the fact that there are three of them for each saddle. Their arrangement is also faulty. There is no stiffness to the saddle to give it stability and when packed it has a tendency to revolve about a line at, and parallel to, the lower edge of the saddle bar of the ordinary saddle when on the animal. The saddle frame is too short not only for giving proper support to the load but also for properly distributing the weight on the animal's back.

The ammunition carriers and the method of attaching them are very satisfactory.

Some of the shafts do not revolve independently of the gun carriage, so when the latter upsets, the pack animal in the shafts will be thrown. I found this to be a great fault with the Hotchkiss 3-inch mountain gun in the field when my saddles broke down and I had to draw the gun on its carriage.

On this trip or "hike" referred to, I marched about 110 miles in the Province of Sorsogon, P. I., November, 1900, with one 3-inch Hotchkiss M.G. Of the five pack saddles I had with me, four broke down, the wooden frame giving away during the first thirty miles. This weakness in the wooden frame can easily be remedied by binding them with iron as I suggested to the Ordnance Officer in Manila at the time. But even with this repair the saddle is not a good saddle and should be discarded as it is constructed on wrong principles. It is faulty in the frames; in the pads; in the girths; and in fact in everything.

My experience together with my study of the subject has convinced me that the ideal pack saddle for a mountain gun can be obtained by properly combining the principles of the aparejo and the McClellan saddle. We should then have a type saddle which should differ only in size and in the upper part of the frame which should be detachable so that the saddle could be used for every type of gun and for any particular piece of any one type.

Like the McClellan saddle it must have hard leather-covered bars fitting the pack animal like the saddle and taking the top load; like the aparejo it must have stiff leather sides to take the side loads, and to give stiffness and stability to the saddle not only for carrying the top load but also for proper cinching.

Each saddle should be provided with one saddle cincha and that should be about eight inches wide and be made of heavy canvas. It should be cinched and not buckled. There should also be cargo cinchas specially constructed for the particular load intended.

The parts of the frames should be of the best Jupiter cast-steel or channel steel.

The Ordnance saddle for the Hotchkiss 2-pounder mountain gun pack is a good model and gives a good idea of how the principles of the McClellan saddle and the aparejo can be combined to form an ideal pack saddle for a mountain battery.

Very respectfully,
F. E. Johnston,
Captain, Artillery Corps.

# SPECIAL REPORT OF FIRING WITH VICKERS-MAXIM Q. F. MOUNTAIN GUN.

COMMUNICATED BY THE CHIEF OF ARTILLERY, U. S. A.

Fort Leavenworth, Kansas,
*January 29th, 1903.*

The Chief of Artillery, U. S. A.,
Washington, D. C.

Sir:

I have the honor to submit the following special report of the preliminary firing of this battery with the Vickers-Maxim quick-firing mountain gun, believing that it will be of interest, and perhaps benefit, to the other batteries equipped with the same gun.

On October 7th, the battery was directed to have a practice in firing before the Assistant Secretary of War and the Acting Adjutant General of the Army, and 25 shrapnel were fired at each of two ranges (2500 and 3000 yards) at a group of three standard targets (20 feet by 10 feet) arranged in line and column respectively. This practice, while not entirely unsatisfactory, considering the very long ranges and the fact that the battery had never fired a shot before, and consequently knew nothing regarding the ammunition on hand, was still sufficiently poor to render necessary some systematic work to determine the equation of the ammunition, before the subsequent practice could be expected to be satisfactory.

The following practical method was accordingly determined upon and carried out: Five ranges (500, 1000, 1500, 2000 and 3000 yards) were accurately measured with a transit, and five common shell and five shrapnel were fired at each range—the shell for ranges and the shrapnel to determine the rate of burning of the time fuzes.

For the shell, the sight, which is graduated to yards, was set in each case to the proper range and accurately aimed, each sight being verified by myself. The variation of each shot from the measured range was measured and the mean taken for each range. The time of flight was also taken with four stop watches and the mean taken.

In the case of the shrapnel the piece was aimed and the fuze set so as to give a burst in front of and above the target, the time of burst being taken by stop watches, and the range of burst by the range party situated about 500 yards to the right of, and on a line with, the target, use being made of 12 flags, placed at intervals of 25 yards, eight in front and four in rear of the target. The mean of the times and ranges of burst was taken for each measured range. With the data thus obtained the curves given in plate herewith were constructed.

The horizontal ordinates in all of the curves are the actual ranges.

In curve No. 1 the vertical ordinates are the actual heights in inches, on the tangent sight scale corresponding to the different ranges.

Curve No. 2 is constructed by points—the vertical ordinate of each point being the actual height on the sight at which the piece was fired, and the horizontal ordinate, the mean range obtained by actual firing.

Curves 3 and 4 were likewise constructed by points—the horizontal ordinates beng actual ranges of burst, and the vertical ordinates being, in the case of No. 3, the actual time of flight to burst, and in case of No. 4, the actual setting of the fuze.

Curve No. 4 gives therefore the actual setting of the fuze corresponding to the different ranges, while curve No. 3 gives the actual time of burning.

From these curves the annexed table (columns 1, 2 and 3) was constructed and used in the subsequent firing. Column 1 gives the actual ranges, column 2 setting of tangent sight necessary to reach ranges in column 1, and column 3 gives the setting of the fuze corresponding to ranges in column 1.

The results obtained in the subsequent practice were sufficiently good to more than repay for the time and ammunition expended in the work above described. As for example, on the first day's regular practice, at known ranges with common shell, for accuracy, a standard target was fired at, at 1300 and 2050 yards. With the elevations given in the table, 19 direct hits were obtained out of thirty shots at the first range and all of the shots were in a rectangle 30 yards long, while at the longer range, 6 direct hits were obtained out of thirty shots and all of the shots were in a rectangle 50 yards in length, except one which struck 40 yards short.

At each range about 2/3 struck over and 1/3 short.

The subsequent firing with shrapnel also confirmed the correctness of the fuze setting in column 3 of the table.

The result obtained by firing shrapnel for range indicated that about $\frac{1}{50}$ of range for common shell should be added when firing shrapnel.

As the graduations of the tangent sight of the gun are in yards. and on a detachable strip of brass, the practical way of making use of the data obtained by the experimental firing, is to have new strips made, and in column No. 5 of the table will

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Ranges *Yards.* | Setting of present sight to reach range in Col. 1. | Corrected fuze scale *Seconds.* | Fuze scale taken from plate on cradle of gun. | Actual heights in inches necessary for graduation of new sight scale. |
| 100 | | | .50 | .13 |
| 200 | | | 1.00 | .25 |
| 300 | | | 1.50 | .37 |
| 400 | | | 2.25 | .50 |
| 500 | 550 | 2.25 | 2.75 | .63 |
| 600 | 655 | 2.70 | 3.25 | .76 |
| 700 | 765 | 3.15 | 3.75 | .89 |
| 800 | 875 | 3.65 | 4.25 | 1.02 |
| 900 | 980 | 4.15 | 4.75 | 1.18 |
| 1000 | 1090 | 4.65 | 5.50 | 1.30 |
| 1100 | 1195 | 5.15 | 6.00 | 1.44 |
| 1200 | 1300 | 5.70 | 6.50 | 1.58 |
| 1300 | 1405 | 6.20 | 7.25 | 1.73 |
| 1400 | 1510 | 6.70 | 7.75 | 1.88 |
| 1500 | 1615 | 7.25 | 8.25 | 2.03 |
| 1600 | 1720 | 7.80 | 9.00 | 2.19 |
| 1700 | 1825 | 8.35 | 9.50 | 2.35 |
| 1800 | 1930 | 8.90 | 10.25 | 2.52 |
| 1900 | 2035 | 9.50 | 10.75 | 2.69 |
| 2000 | 2140 | 10.10 | 11.50 | 2.87 |
| 2100 | 2245 | 10.70 | 12.25 | 3.05 |
| 2200 | 2355 | 11.30 | 12.75 | 3.23 |
| 2300 | 2460 | 11 95 | 13.50 | 3.42 |
| 2400 | 2565 | 12.60 | 14.00 | 3.61 |
| 2500 | 2670 | 13.25 | 14.75 | 3.79 |
| 2600 | 2775 | 13.90 | 15.50 | 3.99 |
| 2700 | 2880 | 14.60 | 16.00 | 4.19 |
| 2800 | 2985 | 15.25 | 16.75 | 4.39 |
| 2900 | 3090 | 16.00 | 17.50 | 4 60 |
| 3000 | 3195 | 16.65 | 18.00 | 4.81 |
| 3100 | 3305 | 17.40 | | 5.03 |
| 3200 | 3410 | | | 5.26 |
| 3300 | 3515 | | | 5.50 |
| 3400 | 3620 | | | 5 75 |
| 3500 | 3730 | | | 6.02 |
| 3600 | 3840 | | | 6.30 |

be found the actual measurements in inches necessary for graduations of new scales.

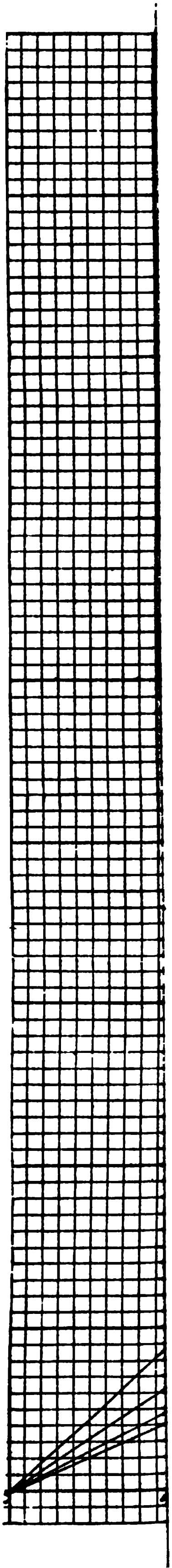
A comparison of curves 3 and 4 will show the discrepancy between the actual rate of burning of the fuze and that indicated by the scale on the fuze itself. The fuze in question is the English "time and percussion fuze, Mark IV".

The only data on hand at the beginning of the practice regarding the fuze was the fuze scale on a brass plate attached to the cradle.

This scale is given in column No. 4 of the table.

The original plotting of the results of the firing above described was made on a much larger scale than that shown in plate and is believed to be fairly accurate.

Very respectfully,
CHAS. T. MENOHER,
Captain, Artillery Corps,
Commanding 28th Battery, Field Artillery.



# FIELD ARTILLERY SIDE ISSUES FROM A VETERINARY STANDPOINT.

By Veterinarian GERALD E. GRIFFIN, Artillery Corps.

Matters of an equine nature, so far as they relate to feeding and stable management, have become so subservient to usage and the customs of the service that a few remarks from one, though ever so insignificant, who has given the subject considerable thought and study, may have some slight chance of doing good by offering food for reflection.

I am very sure that if the ideas herein contained are considered futile or dangerous, if they are weakly conceived or improperly timed, it will be seen there is nothing exterior to them, the only object being to lengthen the official life of the artillery horse by a year or more, and it is believed that this can be readily accomplished.

There is nothing in the proposition to dazzle or deceive. It will be seen just as it is and, I trust, treated as it deserves.

My object in placing these few generalities before artillery officers is not that of criticism, but rather to bring to their attention in a more or less lucid manner the evil results of an improper feeding system and the benefits which may be derived from a change to a more rational one.

To change the customs of the service as deeply rooted as are ours, in this respect, is, merely in the attempt, an undertaking of gigantic proportions, an attempt that may be pardoned even by those whose minds are not properly disposed for its reception. Struggling a good many years with this thought, by degrees I felt myself more firm, and derived at length some confidence from what, in other circumstances, usually produces timidity. And I have grown less anxious, even from an idea of my own insignificance, situated as I am without rank or authority, and totally destitute of all shadow of influence, natural or adventitious.

When I first had the honor of an appointment as veterinarian in the army the system of feeding and stable management pressed themselves upon me as the most important and most urgent objects of veterinary attention ; my little share in this, to me, important matter oppressed me. I found myself a partaker in a very serious trust, and having very little reason to rely on my natural abilities for the proper execution of that trust. I was obliged to take more than common pains to instruct myself in everything which relates to feeding and its effect. I was not less under the necessity of forming some fixed ideas concerning the policy of the authorities in this connection.

I really did not think it safe or soldierly to advance my opinions amid so vast a fluctuation of ideas and theories then existing on the subject, but I had the good fortune to find myself in perfect concurrence with a large majority of the leaders in the veterinary profession. Bowing under the opinion of these leaders and penetrated with the sharpness and strength of that early impression, I have continued ever since, without the least deviation in my original opinions. Whether this be owing to an obstinate perseverance in error, or an adherence to what appears to me truth and reason, is left to those who give my ideas serious thought to judge.

The first thing to be considered with regard to the nature of the subject is the number of horses in the Field Artillery; this number is little short of four thousand, whose average length of service is presumably nine years in time of peace; the average cost of each individual is probably one hundred and fifty dollars, making a total value of six hundred thousand dollars. To maintain this motive power in an efficient condition requires an annual expenditure of probably forty-five or fifty thousand dollars irrespective of subsistence and veterinary service. There is no attempt at exaggeration here where plain truth is of much weight and importance. But whether I put the cost of maintenance too high or too low, is a matter of little moment.

I put this consideration of the subject in advance because it will make it evident to discernment, even blunted by usage, that no partial, contracted routine system of convenience is at all suitable where such a sum is involved and where the proficiency of each battery depends upon this motive power, and this is, if I mistake not, a point of view, from which, if the subject is looked at, it is impossible that it should not make an impression.

Our system of feeding and stable management is accepted as a matter of course by incoming battery commanders and appears to have been handed down from time immemorial without reference to the importance of the subject; the system is almost too well known to need repetition here. It is as follows:

EVENING STABLES.

Water.
Grain.
Hay.

This is reversed the following morning.

MORNING STABLES.

Hay (what remains in rack from preceeding "feed").
Grain.
Water.

While between the morning (generally 5:30,) and the evening (often 5 o'clock) "feeds" no portion of the ration is offered, irrespective of the conditions under which the animal may exist. Bran and salt are offered at irregular intervals, the former often in a very unattractive form.

These well known details have been given because generalities, which in many other cases are apt to heighten and raise the subject, have here a tendency to sink it.

I pass now to the effects of the system as observed throughout a number of years. On entering the service the remount, taken from his country home where he was permitted the freedom of the fields, or if working, received three meals daily, morning, noon and evening, and having just passed through the excitement of the horse marts with their accompanying indigestion and exposure, is suddenly compelled to adopt himself to the feeding scheme of the service, the fuze of which appears to be cut at zero. His first day of military life commences with a cleaning, this is supplemented by a drink of water followed immediately by a full ration of hay and half a ration of grain, whichever he may choose to eat first. As he is ravenously hungry, if in good health, after his enforced fast from early morning, he selects the latter, it requiring less mastication and insalivation to prepare it to be gulped down to the relief of the supplicating stomach. By the time the last of this imperfectly masticated grain has reached that organ the pressing demand has been satisfied, when he leisurely partakes of the hay; this leisure manner with the hay is a necessity, as it cannot be imperfectly masticated and insalivated and then an attempt made to swallow it with impunity. The partially masticated grain passes into the small intestines unacted upon by the gastric juices, to any appreciable extent. It may act as an irritant to this portion of the digestive tract and produce diarrhœa or spasmodic colic, or undergo fermentation and cause flatulency; in any event the portion acted upon the least passes off per rectum in a condition approaching its original form, undigested and unassimilated, the animal losing in this way probably one-third of the grain furnished or approximately two pounds. The following morning the grain ration is again placed before him. This is partaken of with comparative slowness, the appetite not being quite so keen and the stomach still containing much hay.

It may be well to remember at this point that the capacity of the stomach of the average artillery horse does not exceed fourteen quarts. It contains at the morning feeding hour probably four pounds of hay; on top of this it receives six quarts or pounds of grain, it contains now approximately ten quarts or is about two-thirds full; immediately after the grain has been consumed the battery arrives, when the animal is led to the watering place where he partakes of from nine to sixteen quarts of water, depending on the season of the year. We know the water imbibed does not remain in the stomach, but passes on immediately to the small intestines and from thence to the "caecum" or "water stomach", a cul de sac of the large intestines situated in the region of the right flank, where it is stored. The water, as it leaves the stomach, carries with it a considerable portion of its contents and with this portion a fair proportion of the grain which escapes the action of the stomach juices, rendering it less likely to be further digested, elaborated and assimilated, and causing it to pass off posteriorily as waste material. I am persuaded that from one to two pounds of the morning portion of the grain ration passes off as such. This remains a daily occurrence until death or condemnation terminates it.

The conclusion to be drawn from this statement, if the details are admitted in the gross, is that we must acknowledge a waste of from two to three and one-half pounds of grain daily for each horse, even when his digestive apparatus has accommodated itself to the new order of things.

Admitting even that the proposition is only theoretically correct, although we have time and again demonstrated its practical correctness to our own satisfaction by numerous post mortem examinations and long continued observation, and remembering the long fasts, from 5:30 a.m. to 5:00 p.m., is it not surprising that so few of our horses die of digestive troubles in their recruit year, and can it be wondered at that new or "green" horses do not do well in our hands for from 5 to 12 months; that they suffer readily and frequently from all the vicissitudes of equine ailments even though promptly and invariably dosed with the foul and disgusting draughts of the veterinary dispensary, while the real specific remains in the hands of those who by their position and authority control the feeding, while their companions in the hands of the civilian, whose horse is fed as often as himself, can be depended upon to do harder work continuously after a rest of a few days.

I will make the statement, which is beyond successful refutation, that 80% of our most alarming equine digestive troubles occur between the hours of 6 and 11 p.m., and those of a less alarming nature between 7 and 10 a.m. If this statement is accepted as correct the causes of the trouble are not far to seek.

I think it will be perceived that in comparison with man or with any other animal with which we are acquainted, the horse possesses the smaller stomach in proportion to weight, and that this would point to his being fed a small quantity at a time but often, and that the fact is clear and indisputable, namely, that the long fasts are exceedingly injurious and have a strong tendency to derange the digestive apparatus.

Reasoning then from the facts more or less clearly presented for consideration and knowing from long association the military conditions governing, my scheme would be as follows:

EVENING.

Water.
Groom.
Hay, 10 lbs., to be followed from one-half to one hour later by
Grain, 5 lbs.

MORNING.

Grain, 5 lbs., to be followed not earlier than two hours later by
Water.

NOON.

Hay, 4 lbs., distributed around fence of corral or placed in a simple rack.

Salt should be within the reach of the animal at all times. It is preferable to have it in the corral in the shape of "rock" salt.

Bran should be fed by section on successive days and should be thoroughly mixed with hot water and a proper quantity of salt; the latter has a tendency to prevent fermentation.

Ten pounds of grain (oats of course, corn is unsuitable except in emergency and should be very carefully given) and fourteen pounds of hay are amply sufficient in garrison if given in the above manner. In the field the allowance could still be 12 pounds of grain, two of which should be carried in the nose bag (the mouth stuffed with from one to two pounds of hay) on the carriage and offered at the noon halt. This would certainly refresh the horses and prevent the falling away in flesh to a great extent.

The saving on grain in the course of a year (oats costing one cent per pound) would be very considerable indeed.

It is well known that artillery drill regulations require that the horses shall be fed part of the hay ration at noon, but it is believed this paragraph is a dead letter.

# PROFESSIONAL NOTES.

## ARTILLERY MATERIAL.

### Ship Armor and its Attack.

BY "GUNNER."

Since its introduction in 1855 for the protection of ships of war, armor has undergone many changes, and before considering the varieties at present in use, it will be as well to run through the story of its evolution.

The plates first employed were of wrought iron, a comparatively soft but tough material, which was ultimately completely defeated by the chilled iron Palliser projectiles introduced for the purpose.

Early in the eighties, wrought iron was superseded by both steel and compound armor. The latter, which was composed of a wrought iron back, to which was welded a hard steel face, presented the ideal combination of a tough body to hold the plate together and a hard surface to resist penetration.

Compound armor was largely used in England, and also by the Italians, Germans, and Russians, but the tendency in France and the United States was always towards the all-steel plate, and this eventually took a decided lead of its compound rival. This was shown by experiments at Spezzia in October, 1884, and more conclusively in the autumn of 1890 during competitive trials at Annapolis and Ochta.

As chilled-iron projectiles failed against the foregoing type of armor, forged-steel were introduced, and the gun was again getting the better of the plate when in 1891 various inventors introduced methods of surface-hardening, the best known of these being those of Harvey and of Tressider. Mr. Harvey's method consisted of carburising the surface of a suitable steel plate and subsequently water-hardening it, the result being a plate with an intensely hard surface, which broke up projectiles on impact. It possessed the merits of the compound plates, viz. a hard face and a tough back, without the great defect of those plates, a tendency for the face to crack and become detached from the wrought iron body.

The relative resisting values of wrought iron, compound or all steel and Harveyed plates, may be given roughly as 1, 1.3, and 2.

Between 1880 and 1893, in consequence of the extreme thickness of compound or wrought iron required to give adequate protection to battleships against the powerful ordnance then employed, their armor was necessarily very limited in area, and notable examples of ships with thick and small armored patches are the Inflexible and the Admiral class.

Consequently, although armor-piercing projectiles were necessary for the attack of these thick plates, the greater part of the ship was unarmored and exposed to the attack of common shell. The secondary guns were quite unprotected, or protected only partially, and the introduction of Q.F. guns and high explosive shell made the prospect of an engagement anything but pleasant to the men behind the guns.

However, the adoption of Harveyed armor made it possible to double the armored area, and the secondary guns, as well as the primary, were afforded protection. The Majestic class were the first British battleships to employ Harveyed armor, and a glance at the plans of the Majestic and Inflexible will serve to illustrate the gain in protection due to the adoption of the Harvey process. Of course some of the additional protection was gained by the greater displacement of the later ships.

Harveyed armor, however, was destined to be soon superseded by the Krupp product, made by an analogous but improved process, which gave an equally hard face, and a tougher body to the plate. Two distinct classes of Krupp plates are made, cemented and non-cemented – K.C. and K.N.C., for short. Both are oil or water hardened, but the latter is not carburised on the surface. K.N.C. is reported to be very variable in its behavior, its average figure of merit compared to wrought iron is probably about 2.25. The figure of merit of K.C. varies with the thickness of the plate. With the 6-inch to 9-inch plates it may be anything from 3 to 2.5; with plates over 9 inches it averages about 2.2.

It is found difficult in practice to get uniform results with K.C armor under 5 inches in thickness, more particularly where the surface of the plate is curved, as in the case of casemates, and in this and similar instances K.N.C. plates are mostly used.

The steel employed in modern armor is not a simple compound of iron and carbon, but is alloyed almost invariably with nickel, and very often with chromium, Nickel has the effect of toughening the steel, while chromium exercises a hardening influence.

Till recently all steel plates have been pressed or forged, but Krupp exhibited at Düsseldorf last year some cast steel armor which was apparently every bit as good as forged steel, and had the advantages of comparative cheapness and adaptability to curved structures, such as turrets or casemates.

It is well to note in this connection that the late Captain Orde Brown was of opinion, which he gave expression to in the supplement to "Armor and its Attack," that although hard-faced plates resist the attack of A.P. projectiles with comparatively high striking velocities very much better than unhardened plates, yet against common shell, which have no points to break, or against A.P. with low striking velocities (under 1500 f.s.), they present no superiority. Indeed, if this be so, they are, owing to their liability to crack, if anything, inferior.

The next point to consider is our means of attacking an armored target. Guns may be roughly classified as heavy, medium, and light, according to calibre, over 9.2 inches heavy, 9.2 inches to 4.7 inches inclusive, medium, and below 4.7 inches light. The projectiles employed are armor-piercing shot, ar-

| Gun. | Weight of proj'ile | Muzzle velocity. | Striking velocity. | | Penetration (to nearest ¼″) | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 3000 yards | 4000 yards | 3000 yards | | 4000 yards | |
| | | | | | W.I. | K.C.S. | W.I. | K.C.S. |
| 12″ Mk. IX. | 850 lbs. | 2480 f.s. | 1991 f.s. | 1855 f.s. | 28.5″ | 13″ | 25.5″ | 11.5″ |
| 9.2″ Mk. IX. | 380 " | 2640 " | 1987 " | 1815 " | 21.5″ | 9″ | 19″ | 8″ |
| 7.5″ | 200 " | 2700 " | 1890 " | 1683 " | 16″ | 6.5″ | 13.5″ | 5.5″ |
| 6″ Mk. VII. | 100 " | 2640 " | 1674 " | 1436 " | 10.5″ | 4.25″ | 8.5″ | 3.5″ |

Muzzle velocities, from Brassey, 1902; striking velocities by Bashforth, penetration by Tressider's formula.

With capped projectiles, striking within 20° to the normal, the penetration of the 12-inch, 9.2-inch, and 7.5-inch at 3000 yards, and the 12-inch and 9.2-inch at 4000 yards, might be increased 25 per cent.

mor-piercing, pointed common, common, and high explosive shells. Pointed common, with the exception of that for the 12-pounder of 12 cwt., is not used in our land service.

The foregoing table gives the penetration, by A.P. shot from typical heavy and medium guns, of K.C. armor at ranges of 3000 and 4000 yards, Tressider's formula for perforation of wrought iron being employed, the K.C. perforation being obtained by dividing that of W.I. by a suitable figure of merit varying with the thickness of the plate from 2.5 to 2.2.

The penetrations given in the above table are for direct hits. At angles of incidence beyond 35° to the normal, projectiles cannot be depended upon to bite, and in most cases would glance, just scooping a shallow piece out of the surface of the plate.

A.P. shell have probably about ⅞ inch the penetration of A.P. shot, but it is very doubtful whether they could ever carry their bursting charge through this thickness of armor, more especially when the burster is a high explosive, which is liable to detonate on impact.

For common shell a penetration of from one-half to two-thirds the calibre of the shot may be expected in unhardened steel. It is extremely unlikely that more than a half-calibre penetration would be effected against K.C plates, although in the "Treatise on Ammunition" it is stated that with a striking velocity of 2000 f.s. pointed common can get through two-thirds their calibre hardened steel.

High explosive common shell cannot be expected to get through any but the thinnest armor, say a quarter to one-third of a calibre.

When one does get through, the effect of its burst appears to be more violent but also more local than that of a powder shell. It breaks up into very much smaller pieces and has a much wider angle of burst As a man-killing projectile, it is probably superior to ordinary common, but its effect on material, except in a closely confined space, seems likely to be less, and its value as an incendiary projectile is also probably less.

It is impossible, however, to speak with any certainty in the matter, as all recent experiments have been conducted with the greatest secrecy, and the results kept confidential.

The table on page 320 gives the armor protection of three typical modern battleships, and alongside each column will be found the guns and projectiles with which the armor in question can be successfully attacked.

In the three ships in this table all essential parts are protected by armor from 5 inches to 15 inches in thickness, and unless this armor can be penetrated (except in the case of the belt) fairly often, none of them would be likely to be put out of action. All previous experience, *e.g.* the Huascar *versus* the Almirante Cochrane and the Blanco Encalada, the Chen Yuen at the Yalu, goes to show that an armored ship will stand a great deal of hammering even from guns which are more than a match for her armor under trial conditions.

An A.P. shot, unless it penetrates at the water-line, finds its way into the boilers, or breaks up inside a casemate or turret, will do but little damage. Not much more effect can be expected from A.P. shell, on account of its small bursting charge (only 5 per cent of its weight), and the best results will in all probability be obtained by the use of common or, in the case of the unarmored portions of a ship, of high explosive shell. But to use common effectively, the gun must very much overmatch the plate attacked, and for this reason the advent of the 9.2-inch as part of the secondary armaments of our battleships is to be welcomed.

It is a question whether the 6-inch should not be replaced by the 7.5-inch, which could at least get A.P. shot through a 6-inch Krupp plate at 3000 yards, and would in all probability get shell through as well—at any rate, in the case of N.C. plates.

There are also many old-fashioned ships, French battleships in particular, whose secondary armor could be successfully attacked by the bigger gun with common shell, but which could resist the attack of the 6-inch with this class of projectile. On the other hand, of course the 6-inch has a more easily handled projectile, and its rate of fire is greater in a ratio of about 5 to 3.

| Name of ship. | Thickness belt and armored deck. | Penetrable at 3000 yards by | | | Thickness armored side above belt. | Penetrable at 3000 yards by | | | Thickness barbette, hoods or turrets. | Penetrable at 3000 yards by | | | Thickness armor, heavy-gun bases. | Penetrable at 3000 yards by | | | Thickness armor for secondary guns. | Penetrable at 3000 yards by | | | Thickness armor, fore conning tower. | Penetrable at 3000 yards by | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | C | | A | B | C | | A | B | C | | A | B | C | | A | B | C | | A | B | C |
| | in. | in. | in. | in. | in. | in. | in. | in. | in. | in. | in. | in. | in. | in. | in. | in. | in. | in. | in. | in. | in. | in. | in. | in. |
| Wittelsbach | 12<br>to<br>9 | 12 | Nil | Nil | 6 | 12<br>9.2<br>7.5 | 12<br>9.2 | 12 | 10 | 12 | 12 | Nil | 10 | 12 | 12 | Nil | 6 | 12<br>9.2<br>7.5 | 12<br>9.2 | 12 | 10 | 12 | 12 | Nil |
| | | 12<br>9.2 | 12 | Nil | | | | | | | | | | | | | | | | | | | | |
| Patrie | 15<br>to<br>9 | Nil | Nil | Nil | 5 | 12<br>9.2<br>7.5 | 12<br>9.2<br>7.5 | 12<br>9.2 | 12 | 12 | Nil | Nil | 12 | 12 | Nil | Nil | 6 | 12<br>9.2<br>7.5 | 12<br>9.2 | 12 | 12 | 12 | Nil | Nil |
| | | 12<br>9.2 | 12 | Nil | | | | | | | | | | | | | and<br>5 | 12<br>9.2<br>7.5 | 12<br>9.2<br>7.5 | 12<br>9.2 | | | | |
| Borodino | 13<br>to<br>8 | 12 | Nil | Nil | 6 | 12<br>9.2<br>7.5 | 12<br>9.2 | 12 | 11 | 12 | Nil | Nil | 10 | 12 | 12 | Nil | 6 | 12<br>9.2<br>7.5 | 12<br>9.2 | 12 | 11 | 12 | Nil | Nil |
| | | 12<br>9.2 | 12 | Nil | | | | | | | | | | | | | and<br>5 | 12<br>9.2<br>7.5 | 12<br>9.2<br>7.5 | 12<br>9.2 | | | | |

Thickness of armor from Jane's "Fighting Ships, 1902." Armor 6 inches and over is taken as K.C. Under 6 inches as K.N.C.

Relative penetration, A.P. shot, A.P. shell, and common shell as 1, 0.83, and 0.58.

A = A.P. shot. B = A.P. shell. C = Common shell.

A word as to the value of the cap. Under favorable conditions the cap has increased penetration about 25 per cent, the conditions being a fairly high striking velocity (not less than 1800 f.s.), and an angle of incidence of not more than 20° to the normal. At lower striking velocities, and at greater angles of impact, the cap probably hinders rather than assists penetration, and as these are the conditions which would mainly obtain on service, it is not surprising that our naval authorities have hitherto hesitated to adopt it. Also the body of the projectile must be strong enough to withstand the shock of impact without breaking up, if benefit is to be derived from the cap, and this makes it unsuitable for A.P. shell, which almost invariably break up, unless they greatly overmatch the plate attacked. A.P. capped shot, however, might be of value at comparatively close ranges, in the final stages of a naval engagement.

The relatively high value of the heavy guns, 9.2-inch and upwards, is apparent from a consideration of the above tables.

There is hardly any armor now afloat which will keep out the A.P. projectiles of the 12-inch Mk. IX. and foreign guns of equal power, and these guns can put common shell through nine-tenths of the secondary armor. The effect of the bursting of a heavy common shell of this type is disproportionately great. A single 12-inch shell is reported to have put 120 men on the Matushima *hors de combat* at the battle of the Yalu, and few ships would continue fighting after two such shells had penetrated their armor and burst between decks.

We are never likely to go back to the monster 110 and 100 ton guns of some years ago, but everything at present tends to show that the smallest medium gun in future designs will be the 7.5-inch.

For combined power and simplicity it would be hard to find, among existing designs, a better armament than that of the new Chilian battleships Libertad and Constitucion, viz. four 10-inch, fourteen 7.5-inch, and fourteen 14-pdr., but it would not be surprising in the immediate future to see a class of ship designed to carry (in addition to machine guns) two types of gun only, viz. a main armament of eight to ten 9.2 inch, and a secondary battery of 4-inch.

Such ships would, of course, be members of the "intermediate" class now coming into favor, of which the Vittorio Emanuelé is a well-known example, and would realize Lord Charles Beresford's ideal of a ship with the smallest effective heavy gun and the heaviest effective small gun. Belt attack is practically out of the question, except at very close ranges, and it would then be unnecessary, as in such cases, torpedo attack would be far more likely to be effective than gun-fire. The 9.2-inch is quite heavy enough to deal at fighting ranges with most of the secondary armor afloat, though against the latest types of battleships, with 6-inch K.C. and over, nothing under a 12-inch, or at least a 10-inch could be relied on. The light guns are needed to destroy unarmored parts and to repel torpedo-boat attacks. For these purposes the 6-inch is unnecessarily heavy and the 12-pounder is too light. The 4-inch seems a suitable compromise.

Seeing that the modern battleship is so well protected against direct fire, but so weak against high-angle fire (armored decks are rarely over 3 inches in thickness, and unless the upper deck, as in the King Edward, is armored, there is no other horizontal protection), it is strange that in this country we have not paid more attention to the latter. Against so large a horizontal target, and aided by the P.F., fire from howitzers in coast batteries against ships should be extremely accurate. We have, however, only a few converted 9-

inch and 10-inch R.M.L. on high-angle mountings, whereas both in Germany and the United States great reliance is placed on high-angle fire, and the 11-inch B.L. howitzer and the 12-inch mortar are prominent features in the armaments of their respective coast fortresses.

—*United Service Magazine*, April, 1903.

## A Set-Back and Prediction Scale for Fire Direction.

BY CAPTAIN S. F. BOTTOMS, ARTILLERY CORPS.

The following describes a device for locating mechanically the predicted, set-back, and relocated points:

This scale is constructed on two straight-edges hinged in the center as shown in the plate. The scale when used is in the form of a **V** or a pair of compasses, the working edges of the scale being the two inner edges. The arms of the scale are maintained at any given angle by means of the arc and clamp.

The inner edges are beveled, and the scale is graduated as shown in the plate, and as set forth in the appended tables. The intersection of the inner edges is the center of the hinge.

The scale should be made of German silver, and the thickness of the arms should be $\frac{1}{32}$ of an inch. A greater thickness may be used at the hinge to insure rigidity.

The fundamental principle upon which the scale is graduated, is shown in the Mortar Scale, Fig. 1. This scale is graduated on each arm up to one minute, in seconds; the next mark is the two minute (2′) graduation, which is at the end of the arm. One minute equals six (6) inches. The scale is 10 seconds to the inch. Each 10 seconds is numbered and the fives are indicated. The length of each arm is 12 inches, and all measurements for graduations are taken from the zero which is the center of the hinge.

In the Gun Scale, Fig. 2, only the 20, 30 and 40 second graduations are marked. For the remaining second graduations, are substituted range graduations, which are placed so as to correspond with their respective times of flight, for the particular gun, and muzzle velocity for which the scale is constructed.

The arc is graduated for speed of vessel in miles per hour. The method of graduating all of these scales is discussed in the Appendix.

### TO SET THE SCALE FOR SPEED OF TARGET.

*Four observations*, 20 *second interval*.—We have thus tracked the target for one minute. Free the clamp and lay the scale so that the two, *minute graduations* (inner edge) coincide with the first and last plotted point. Clamp the arc and the scale is set for speed of target.

*Three observations*, 20 *second interval*.—Set the scale in the same manner using the *forty second* graduations, instead of the *minute* graduations.

*Two observations*, 20 *second interval*.—Set the scale in the same manner, using the *twenty second* graduations.

*Three observations*, 30 *second interval*.—Set the scale in the same manner, using the *minute* graduations.

*Two observations*, 30 *second interval*.—Set the scale in the same manner, using the *thirty second* graduations.

### TO DETERMINE THE PREDICTED POINT.

Set the scale for speed of target. Use the outer edge as a straight edge,

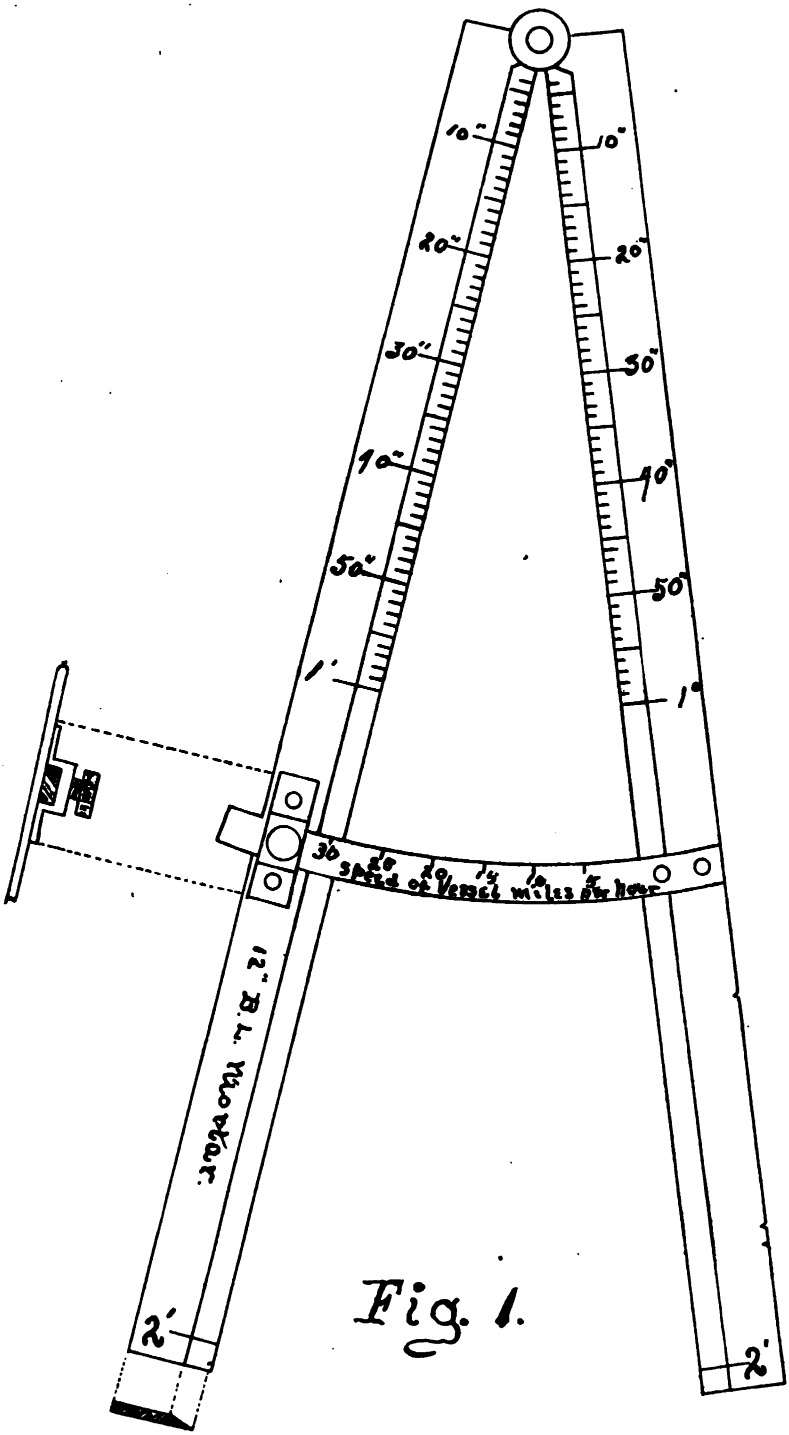

10"
20"
30"
40"
50"
1'
10"
20"
30"
40"
50"
1'
30
28
20
14
10
5
Speed of Vessel miles per hour
12" B.L. Mortar
2'
2'

Fig. 1.

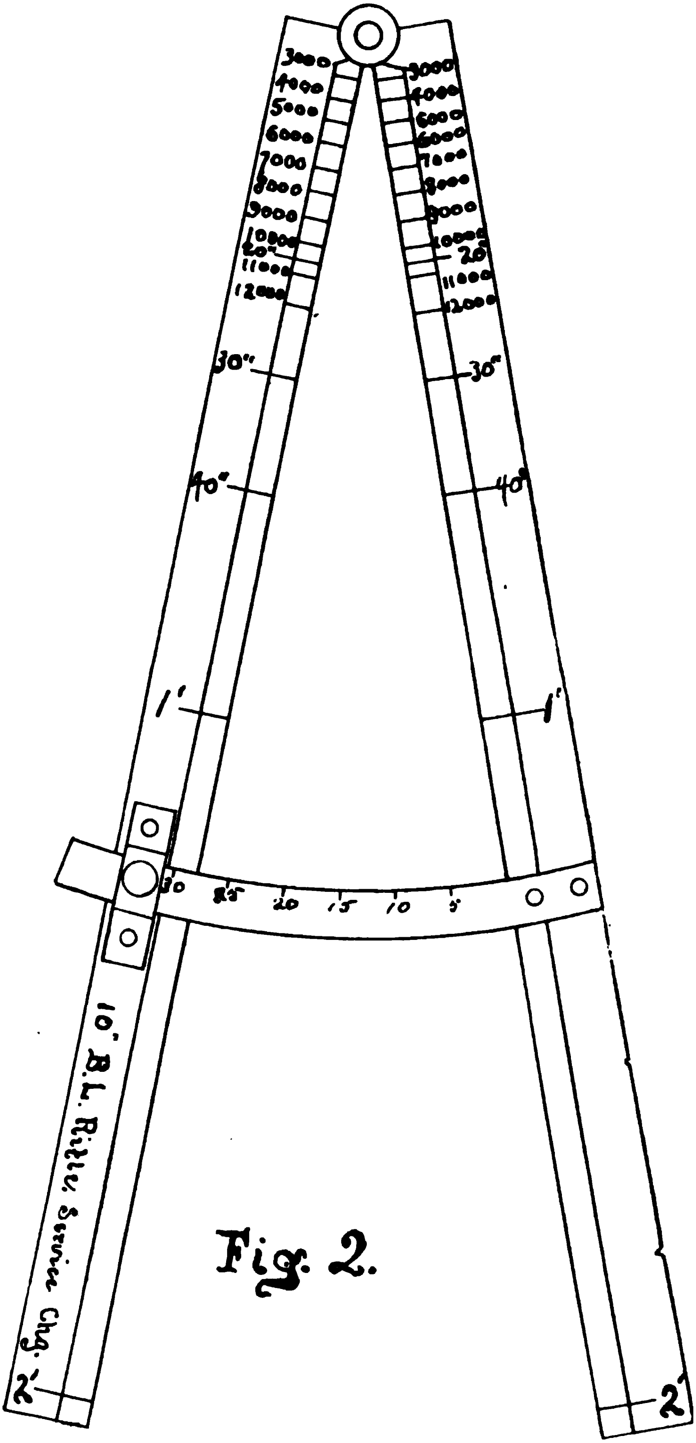

10000
20"
11000
12000
30"
40"
10" B.L. Rifle Service Chg.
10000
11000
12000
30"
40"

Fig. 2.

and prolong the track of the target, on which lay off from any desired point, one or two minute predictions, by means of the distance between the one or two minute graduations.

### TO DETERMINE THE SET BACK POINT.

Determine the predicted point and its range, and mark the set-back point by means of the two graduations of the corresponding range.

For mortars determine the set-back for the time of flight.

The most rapid method for guns will be as follows: On the plotting board lay off range circles for each 1,000 yards from the battery. As soon as the predicted point has been plotted, note its relative position between any two range circles. Lay off the set-back distance for the corresponding position between the range graduations on the scale. Thus if the predicted point is half way between the 6,000 and 7,000 yard range circles, lay off the set-back distance half way between the 6,000 and 7,000 yard graduation on the scale.

Any measure taken on this instrument for set-back or prediction is a chord of the speed angle, and is the distance between the inner edges of the two arms, from any particular graduation on one arm to the same graduation on the other.

To use the instrument, lay it flat on the plotting board, with the graduated side uppermost. Bring the two similar graduations which are to be used, upon the line on which the distance is to be set off. Make the inner edge of one arm coincide with the initial line; such intersection will be the required point.

To determine relocated point: On the outer or inner edge of either arm, two notches are cut at a distance apart equal to the distance on the plotting board between the principal station and the directing gun of the battery Having determined the predicted point place one notch on this point and swing this arm arm around till the line joining notches is parallel to the line joining primary station and directing gun. Mark the position of the other notch. The point so determined is the relocated point, the azimuth and range of which, from the principal station, is equal to azimuth and range of predicted point from the directing gun.

The advantages of this instrument are as follows:

1st. But one tool is required to be used on the plotting board.

2d. It can be used for any predicted interval, and for any number of observations.

3d. It is exceedingly rapid.

4th. It is absolutely accurate.

## APPENDIX.

### MORTAR SCALE.

The graduations upon this scale are merely times of flight. The zero is at the center of the hinge. The arms are graduated to a scale of 10 seconds to the inch.

### SPEED SCALE ON ARC.

This scale is merely intended for easy reference, and it is not necessary that it should be absolutely accurate, it plays no part in the fire direction.

It will be sufficiently accurate to lay off each graduation of 5 miles per hour, for an angle of 4°43′. This graduation will be the same for all scales.

### GUN SCALES.

Theoretically a scale would be required for each gun, and for every muzzle velocity. Practically such is not the case. Scales may be constructed for the service charge for each caliber of gun. This scale may be used without material for quite a considerable variation in velocity.

Example.—12-inch B.L. rifle, range 10,000 yards.

For M.V. 2275, the time of flight = 22.7 seconds.

For M.V. 2025, the time of flight = 25.3 seconds.

Difference 2.6 seconds.

Now let us assume that we have a scale computed for a M.V. of 2275 f.s., but that we are using ammunition having a M.V. of but 2025 f.s. Of course as the predicted point is entirely independent of the M.V. it will be correctly located. There will however be an error in the location of the set-back point equal to the distance travelled by the vessel in 2.6 seconds.

If the vessel is traveling at 12 miles per hour the error will be 15 yards.

If the vessel is traveling at 24 miles per hour the error will be 30 yards. This is of course the extreme case.

Take the same conditions same gun, with a range of 6,000 yards.

M.V. 2275 f.s. $T =$ 9.4 seconds.
M.V. 2025 f.s. $T =$ 10.6 seconds.

Difference 1.2 seconds.

Error, vessel moving 12 miles per hour, 7 yards.

Error, vessel moving 24 miles per hour, 14 yards.

These errors are practically zero when compared with the size of the vessel, the limits of accuracy of the gun, and plotting board.

For the new practice velocity of 1300 f.s. a special scale will have to be constructed.

Thus two scales will be required for each caliber of gun. One for the service and one for the practice charge.

TABLE FOR GRADUATING SCALE, FOR 12-INCH B. L. RIFLE.

| | | | | | | |
|---|---|---|---|---|---|---|
| Range | 3,000 | yards, | Distance | from | center | 0″.425 |
| " | 4,000 | " | " | " | " | 0″.575 |
| " | 5,000 | " | " | " | " | 0″.750 |
| " | 6,000 | " | " | " | " | 0″.925 |
| " | 7,000 | " | " | " | " | 1″.125 |
| " | 8,000 | " | " | " | " | 1″.325 |
| " | 9,000 | " | " | " | " | 1″.550 |
| " | 10,000 | " | " | " | " | 1″.775 |
| " | 11,000 | " | " | " | " | 2″.025 |
| " | 12,000 | " | " | " | " | 2″.275 |

For the purpose of convenience of graduation, these distances in inches are given for the nearest quarter second, which means an error of but 3 yards for a vessel traveling at 24 miles per hour.

The set-back point will not be used inside of 3,000 yards.

TABLE FOR GRADUATING SCALE, FOR 10-INCH B. L. RIFLE.

| | | | | | | |
|---|---|---|---|---|---|---|
| Range | 3,000 | yards, | Distance | from | center | 0″.425 |
| " | 4,000 | " | " | " | " | 0″.600 |
| " | 5,000 | " | " | " | " | 0″.775 |
| " | 6,000 | " | " | " | " | 0″.950 |
| " | 7,000 | " | " | " | " | 1″.175 |
| " | 8,000 | " | " | " | " | 1″.375 |

| | | | | |
|---|---|---|---|---|
| Range | 9,000 | yards, | Distance from center | 1″.600 |
| “ | 10,000 | “ | “ “ “ | 1″.825 |
| “ | 11,000 | “ | “ “ “ | 2″.075 |
| “ | 12,000 | “ | “ “ “ | 2″.400 |

TABLE FOR GRADUATING SCALE, FOR 8-INCH B. L. RIFLE.

| | | | | |
|---|---|---|---|---|
| Range | 3,000 | yards, | Distance from center | 0″.450 |
| “ | 4,000 | “ | “ “ “ | 0″.625 |
| “ | 5,000 | “ | “ “ “ | 0″.825 |
| “ | 6,000 | “ | “ “ “ | 1″.050 |
| “ | 7,000 | “ | “ “ “ | 1″.250 |
| “ | 8,000 | “ | “ “ “ | 1″.525 |
| “ | 9,000 | “ | “ “ “ | 1″.775 |
| “ | 10,000 | “ | “ “ “ | 2″.050 |

## BALLISTICS.

### Vickers' Armor-plate Trials.

This plate, which was made at Messrs. Vickers Sons and Maxim's works at Sheffield, measured 8 feet by 6 feet, and has a thickness of 6¼ inches full. It is made by the Vickers-Krupp cemented process, and was tested at the Eskmeal Range, on the Cumberland coast, first on September 16 of last year, and again on January 16 of this year, the desire being to ascertain whether lapse of time had developed any further effect upon the first attack.

The first shot fired at the plate was at the right top corner, and was from a 6-inch gun with a charge of 14.25 lb. of cordite, the striking velocity being 2110 foot-seconds and the energy 3087 foot-tons. As is shown by Fig. 1, the only effect on the plate was a flaking, and a penetration which did not exceed at any point 1⅞ in.

The second shot, also of the so-called "armor-piercing" type, was at slightly increased energy, but here again the shot was completely broken up, and the parts are shown in front of the plate in our engraving (Fig. 1).

For the third round it was decided to use the 6-inch shot fitted with the Johnson cap, as manufactured at the Barrow Works of the Vickers Company, the weight of the cap being about 7 lb. The striking velocity was about the same as in the two previous shots, with slightly increased energy, due, no doubt, to weight. This shot was directed to the center of the plate, and, as shown in our engraving, the projectile went through the plate and the backing behind. There can be no doubt as to the enormous power of propulsion maintained by the shot after impact; the diameter of the hole made in the plate was only ½ inch more than the shot itself, and there was absolutely no crack in the plate. The extent of flaking from this shot is rather smaller than in the case of the second shot. A piece of the plate, moreover, was driven through the backing and the skin-plate beyond the backing of the armor-plate, and was picked up 38 feet in the rear. The shot was completely broken up; the pieces are shown in the foreground of the engraving (Fig. 2).

As we have already said, it was decided to delay the firing of the next three shots for four months. The fourth shot, which was the first fired on January 16, was aimed near the top left-hand corner, as shown in Fig. 3. It should, perhaps, be explained here that the three original shots had, through lapse of time, got slightly rusted over, which accounts for their black appearance in the engravings (Fig. 3 and 4). The fourth shot was again from the 6-inch gun, and was of the so-called "armor-piercing" type. Here the velocity was 2104 feet per second, and the striking energy over 3000 foot-tons. The plate still stood well up against the attack, the extent of penetration being only 1¾ inches, but there was, as shown in the engraving, very considerable flaking, due probably to the close proximity immediately below of the second round.

RESULTS OF TRIALS OF 6¾-IN. VICKERS-KRUPP ARMOR-PLATE FOR CHILIAN BATTLESHIP "LIBERTAD."

First, Second, and Third Round Fired on September 16, 1902; Fourth, Fifth, and Sixth Fired on January 16, 1903.

| Round. | Weight and Nature of Charge. | Weight and Nature of Projectile. | Striking Velocity. | Striking Energy. | Penetration. | REMARKS. |
|---|---|---|---|---|---|---|
| | | | ft.-sec. | ft.-tons. | in. | |
| 1 | 14.25 lb. cordite $\frac{20}{17}$ | 6-in. A. P. shot, Elswick, 100 lb. | 2110 | 3087 | 1⅞ | Shot broke up completely. No cracks. Flaking measured 22 in. H by 19 in. V. |
| 2 | Ditto | 6-in. A. P. shot, Elswick, 100.75 lb. | 2124 | 3149 | 1⅞ | Shot broke up completely. No cracks. Flaking measured 29 in. H by 20 in. V. (See Fig. 1.) |
| 3 | 14.9375 lb. cordite $\frac{20}{17}$ | 6-in. A. P. shot, Vickers, fitted with Johnson cap; 107 lb. | 2116 | 3323 | Through | This capped shot was fired with a charge giving an equal velocity to Round 2. There was complete perforation of plate, backing, and skinplate. Projectile was broken up in several large pieces, most of which were found in front of plate. A piece of plate was punched through the backing and skinplate, and picked up 38 ft. in rear. Diameter of hole was 6½ in. No cracks. Flaking measured 21 in. H by 13 in. V. (See Fig. 2.) |
| 4 | 14.2187 lb. cordite $\frac{20}{17}$ | 6-in. A. P. shot, Elswick, 100.125 lb. | 2104 | 3073 | 1¾ | Shot broke up completely. No cracks. |
| 5 | Ditto | 6-in. A. P. shot, Elswick, 100.1875 lb. | 2104 | 3073 | 1¼ | Shot broke up completely. No cracks. (See Fig. 3.) |
| 6 | 33.25 lb. cordite $\frac{30}{10}$ | 7.5 in. A. P. shell, fitted with Johnson cap, 204.6875 lb. | 2107 | 6301 | Through | Shell broke up. Point and base plug found 20 ft. in rear. All pieces passed through plate. No cracks (See Fig. 4.) |

NOTE.—The temperature of the charge was 80 deg. Fahr. in all cases. On September 16, 1902, the thermometric readings were 57 deg. Fahr. by dry bulb and 51 deg. by wet bulb, the barometer showing a pressure of 29.6 in. On January 16, 1903, the dry bulb recorded 32 deg. Fahr., and the wet bulb 30 deg. Fahr., while the barometric pressure was 30.17 in.

The fifth shot, from the same gun and at the same energy, was fired at the right centre, and here again the shot was completely broken up, the fragments being exhibited in the foreground of our engraving (Fig. 3).

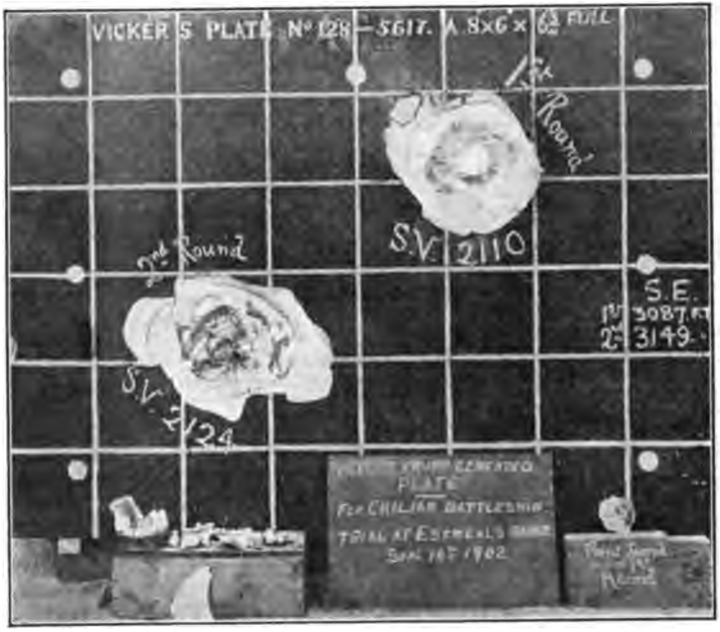

VICKERS PLATE No 128—5617. A 8×6×6½ FULL
1st Round
S.V. 2110
2nd Round
S.V. 2124
S.E.
1st 3087
2nd 3149
PLATE
For CHILIAN BATTLESHIP
TRIAL AT ESKMEALS
SEPT 18th 1902
1st Round

Fig. 1.

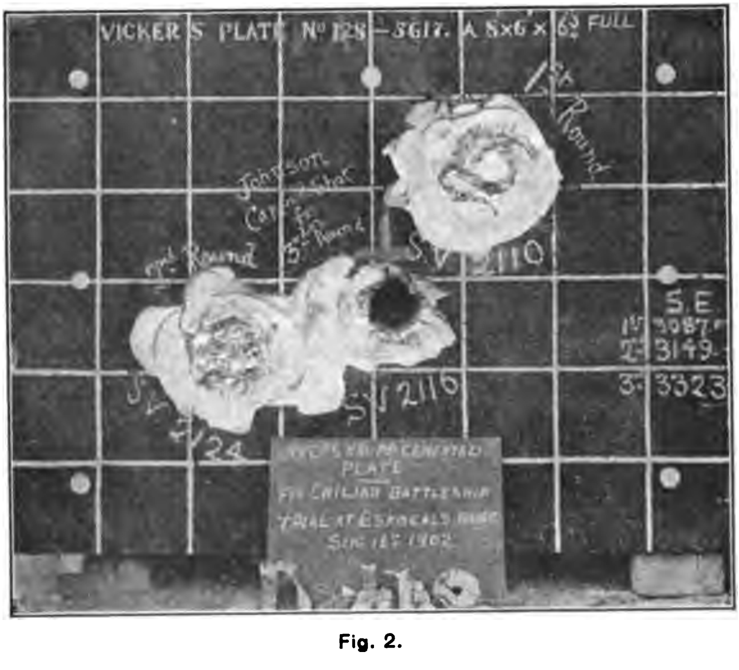

VICKERS PLATE No 128—5617. A 8×6×6½ FULL
1st Round
S.V. 2110
Johnson Cap 3rd Round
2nd Round
S.V. 2124
S.V. 2116
S.E.
1st 3087
2nd 3149
3rd 3323
PLATE
For CHILIAN BATTLESHIP
TRIAL AT ESKMEALS
SEPT 18th 1902

Fig. 2.

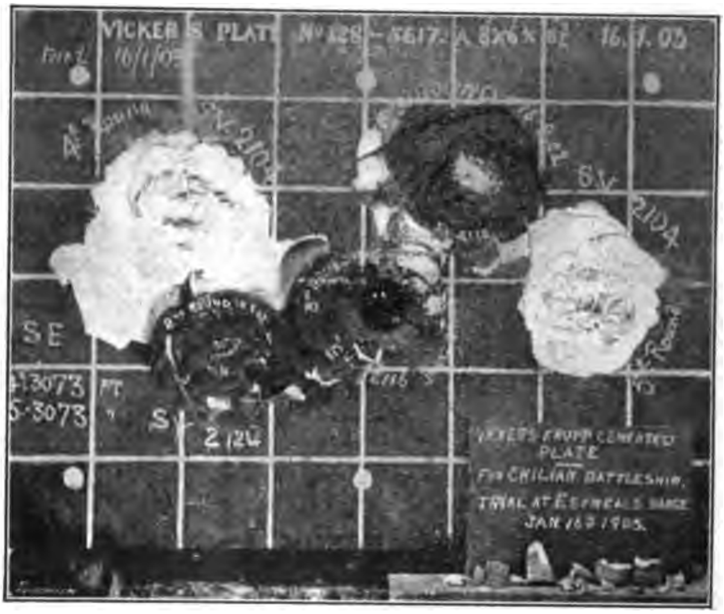

VICKERS PLATE No 128 - 5617. A 8x6x6½ 16.1.03
16/1/03
SV 2104
SV 2104
SE
4-3073
5-3073
PT
SV 2124
VICKERS KRUPP CEMENTED PLATE
For CHILIAN BATTLESHIP.
TRIAL AT ESKMEALS RANGE
JAN 16th 1903.

Fig. 3.

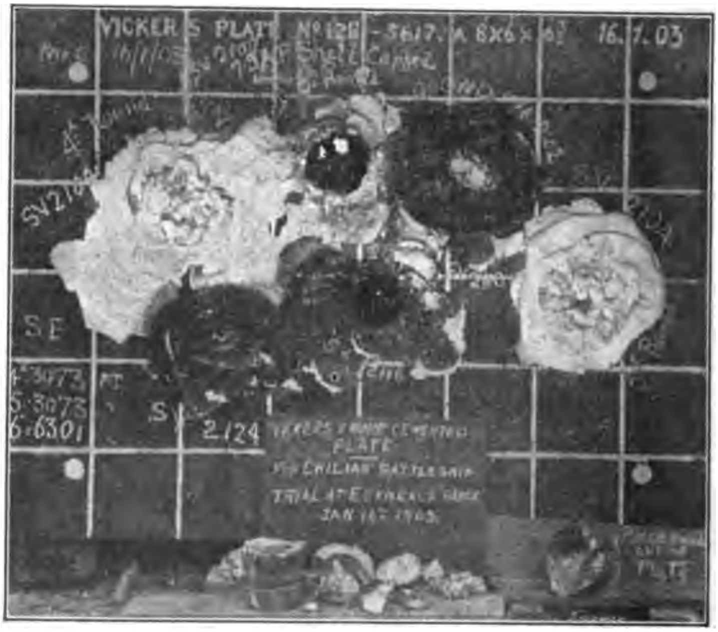

VICKERS PLATE No 128 - 5617. A 8x6x6½ 16.1.03
16/1/03
SV 2104
SE
4-3073
5-3073
6-6301
PT
SV 2124
VICKERS KRUPP CEMENTED PLATE
For CHILIAN BATTLESHIP
TRIAL AT ESKMEALS RANGE
JAN 16th 1903.

Fig. 4.

After this severe trial, it was decided to attack the plate with the 7.5-inch gun, firing an armor piercing shell fitted with a Johnson cap as made by the Vickers Company. Such an attack upon a plate of 7 inches, following on five shots, was a severe punishment. The plate, as seen in the engraving (Fig. 4), shows not a single crack, which is proof of the satisfactory manufacture; but at the same time it was made obvious that Krupp armor, even of the very best quality, cannot withstand an attack from a capped shell. The 7.5-inch gun, with a charge of 33.2 lb. of cordite, developed a velocity of 2107 feet per second, which is not so high as is possible with this weapon using a greater charge, or nitro-cellulose powder. The energy developed was 6301 foot-tons. Even at this comparatively low energy, the capped shot went through the armor-plate, the backing, and the skin-plate beyond. Daylight, as shown in the photograph, appeared through the hole in this case, as well as in that of the hole immediately below it, which had been made by the capped shot from the 6-inch gun; again the diameter of the hole was only a little more than that of the shell. Although the shell in this case was broken into pieces, the fragments passed through the plate, the point and base-plug being found 20 feet to the rear, and, as shown in the foreground of the engraving (Fig. 4), the base-plug was not deformed to any extent.

It is therefore evident that even with this striking energy of 6300 foot-tons it would be possible for an explosive shell to find its way through 7-inch armor into the interior of the ship, and there do very serious damage. The 7.5-inch gun has on other official tests developed a muzzle velocity of 2920 feet per second; and an energy of 11,800 foot-tons—almost double that on the occasion of the attack against this 7-inch armour—so that, with superior propelling powder, it is possible to conceive that the degree of penetration on this occasion could be attained at very considerable ranges. In any case the trial establishes the efficiency of the Johnson cap against the very best armor. As an indication of the quality of the plate, it may be noted that the proportion of energy developed in the attack to the total weight of plate works out at 3730 foot-tons per ton of plate. —*Engineering*, March 13, 1903.

## DRILL REGULATIONS, MANEUVERS AND PRACTICE.

### Manual for the 6-inch Rapid Fire Gun.

(Mounted on U. S. Disappearing Carriage.)

ARRANGED BY SECOND LIEUTENANT THOMAS W. HOLLYDAY, ARTILLERY CORPS.

GUN DETACHMENT.—GUN COMMANDER, GUNNER AND 4 CANNONERS.

| *Name of Detail.* | *Duties and Posts.* |
|---|---|
| *Gun Commander* (Sergeant) | Carries up range scale and difference chart and places them on shelf or table near telautograph or telephone. |
| *Gunner* (Corporal or private, duly qualified). | Carries up sight and places it on sight standard. |
| *Breech Detail* (2 privates, Nos. 1 and 2). | Nos. 1 and 2 assist each other in putting on the sleeves. *No. 1 carries up lanyards and bucket containing oil, placing lanyard and bucket convenient to breech. No. 2 equips himself with primer pouch and wire, secures the loading tray |

| | |
|---|---|
| | and carries it up, placing the loading tray on loading platform convenient to breech. Nos. 1 and 2 remove and replace breech cover, open and close breech, insert and remove loading tray, insert cartridge and see that it is sent home, clean the bore, chamber, breech-box and breech-block and assist in ramming the projectile. No. 2 serves vent. When piece is fired by friction primer No. 1 fires.<br>*Posts.*—Immediately in rear of breech, facing it, No. 1 on right. |
| *Elevating Detail* (1 private, No. 3). | Carries up rammer and prop. Gives the elevation when so directed by the gun commander or gunner.<br>*Post.*—At elevating wheel, facing carriage. |
| *Traversing Detail* (1 private, No. 4). | Carries up traversing crank, oil measure containing oil and funnel. Places traversing crank on shaft and oil measure and funnel convenient to post of No. 3. No. 4 removes and replaces muzzle cover.<br>*Post.*—At traversing crank, facing gunner. |
| *Charge Detail* (4 privates, Nos. 5, 6, 7 and 8). | No. 5 carries up retraction crank and places it on the shaft, also filling-plug wrench and places it convenient to his post. No. 6 carries up bore sponge and prop and places sponge on prop in convenient position. Nos. 7 and 8 each secure a truck. Nos. 5 and 6 lift projectile from truck and place same in position on loading tray. Nos. 5 and 6 assist in ramming and operate the tripping arms. Nos 7 and 8 keep truck of ammunition constantly at gun, No. 7 bringing up full truck as No. 8 leaves piece with empty truck, and so on.<br>*Posts.*—Nos. 5 and 6 opposite the middle of the tripping arms, facing carriage; Nos. 7 and 8, each at his ammunition truck. |
| *Ammunition Detail.* | *One non-commissioned officer and 2 privates.* |
| *Ammunition Sergeant.* | Inspects cartridge room, shell room and any mechanical appliance which may exist for expediting the supply of ammunition. Exercises general supervision over the ammunition supply. Fuzes shell. |
| *Cartridge Detail* (1 private). | Gets out or assists in preparing cartridges. |
| *Projectile Detail* (1 private). | Gets out the projectile directed and assists ammunition sergeant in fuzing shell. |
| *Hoist Detail* (1 private). | Operates shot hoist. |

At the command "Examine gun", the breech and muzzle covers are removed and placed out of the way. The breech is opened and vent cleared. The bore, chamber, breech-box, breech-block and breech mechanism carefully inspected, the parts needing it thoroughly cleaned and the breech closed after inspection; the recoil cylinders opened, examined, filled if necessary and securely closed; the elevating and traversing gear tested; the azimuth indicator tested for adjustment; the level of the traverse circle tested; sight examined; the telephone or telautograph, the electrical and percussion firing gear inspected and tested.

At the command "Load", the breech is opened and vent cleaned; breech-box and breech-block cleaned and oiled if necessary; loading tray inserted; projectile placed on loading tray and rammed home; cartridge inserted and pushed forward by hand until its base barely clears the gas-check seat; loading tray removed; breech closed; primer inserted. If percussion firing gear is to be used, No. 1 then inserts hook of lanyard in the ring of the safety attachment and remains in readiness for the command to fire.

After the gun is loaded the gun commander commands "(1) Prepare to trip, (2) Trip." At the first command the tripping arms are grasped by Nos. 5 and 6 on their respective sides; at the second command the arms are raised and the pawls released.

*Firing.*—The gun commander give the command *No.—*, *Fire* for single shots, or the command *No.—*, *Commence Firing* when rapid firing is employed. When rapid firing is employed the gunner will give the command "Fire" as soon as the piece is properly aimed after hearing the gun commander's command "Ready", which will be given when the piece is fully in battery, and if Case II. be used, when the proper elevation is obtained After firing, the gun is immediately loaded with the same kind of projectile if no other command or direction be given. For commands, etc., for firing single shots see "General Duties, Drill Regulation for Coast Artillery".

### NOTES ON THE MANUAL.

The gun commander and gunner go wherever their presence is necessary.

*Duties of Breech Detail.*—No. 2 opens and closes the breech and cleans the vent; seats and removes the loading tray; helps to sponge the bore and chamber when cleaned; helps ram projectile; inserts cartridge, pushing it forward by hand so that its base barely clears gas-check seat; inserts primer. No. 1 washes out breech-box and breech-block with hand sponge and oil if necessary. If necessary to clean the chamber he uses chamber sponge for that purpose, before cleaning the breech-block, etc. The bore is also cleaned if necessary. No. 1 replaces sponge after using it; helps ram projectile and replaces rammer.

*Charge Detail.*—At the command "Examine gun" No. 5 takes a plug wrench, and, with No. 6, mounts upon the chassis. They unscrew and take out the filling plugs of both cylinders, and ascertain if they contain the proper amount of oil. It is necessary that both cylinders be opened when any filling is done, to avoid the formation of air cushions. If the cylinders are not full, No. 5 calls to No. 3 for the funnel and oil measure, fills the cylinders and passes the funnel and measure back to No. 3. Nos. 5 and 6 then replace the filling plugs, screwing them home, and resume their posts, No. 5 replacing the wrench.

At the command "Load" Nos. 5 and 6 lift projectile from truck; place same on loading tray. After placing head of rammer at base of projectile they assist in ramming, then immediately resume their posts at tripping arms. Nos. 1, 2, 5 and 6 ram projectile at command "Ram" from No. 2, Nos. 1 and 2 nearest breech—even numbers on left; odd numbers on right.

To bring the gun from the firing to the loading position, the gun commander commands "(1) Man the retraction gear, (2) Heave, (3) Halt". At the first command Nos. 5 and 6 mount upon the chassis and place the ends of the ropes on the hooks on the gun levers. At the second command Nos. 3 and 4 take position at the retraction crank and turn the crank until the gun has been brought back to the loading position; when the gun commander gives the third command, Nos. 5 and 6 take the ends of the ropes off the lever hooks.

A change of elevation can be effected at any time during the operation of loading, and the gun can be traversed at all times during this operation except when the projectile is being placed on the loading tray and rammed home.

### Gunnery.

News has come from Bermuda that whilst the Ariadne was at target practice, William Rowe, second class petty officer and seaman gunner, captain of one of the 6-inch quick-firing guns, got off ten rounds in one minute, and hit the target every time. This is claimed as a world's record, and one which is likely to be held for some time, for this performance constitutes a record for the number of hits made in one unbroken series, and also of the number of rounds discharged within a minute.

In view of this the record of the Ocean for 1902 is interesting. With her 12-inch guns she hit, at the rate of 1.41 per minute, seventeen times out of twenty-five rounds, and with her 6-inch guns, at the rate of 4.87 per minute, 117 hits out of 163 rounds. Previously the record had been the Terrible's, with 102 hits in 128 rounds with her 6-inch guns.

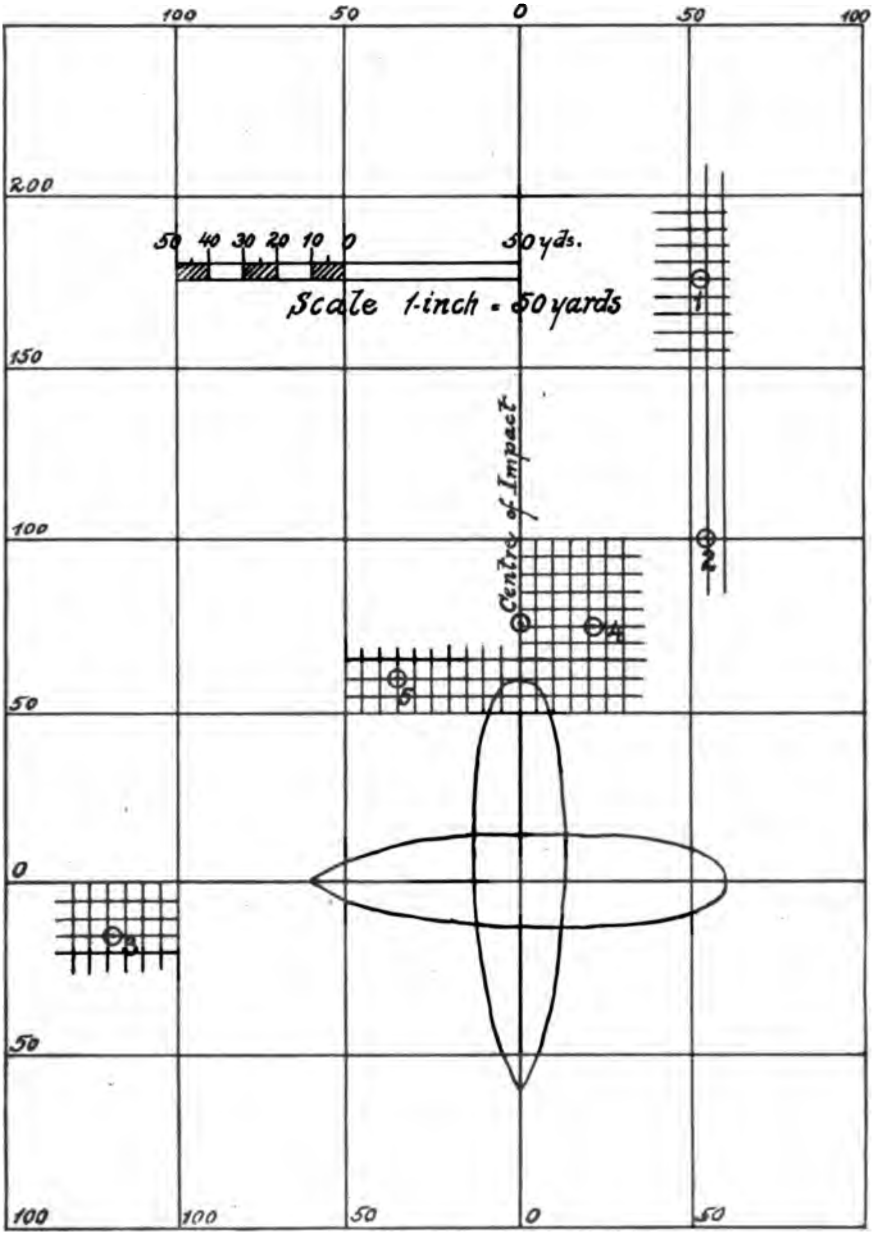
—*Army and Navy Gazette*, April 18, 1903.

### Artillery Practice at Fort Monroe, Va.

The following table gives the results obtained by the companies at Fort Monroe, Virginia, during the recent practice, May, 1903:

| Company | Piece and Carriage | Range Min. | Range Max. | Speed of target | No. of shots in series | No. of hits | | Time to fire series | | Case used | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Yds. | Yds. | m. p. h. | | 1 | ½ | m. | s. | | |
| 6th (Harris) | 10-inch Disappearing | 3020 | 3480 | 8 | 5 | 1 | 2 | 4 | 5 | II | Series interrupted, interfering vessels. |
| 13th (Walke) | 10 inch Disappearing | 2400 | 3000 | 8 | 5 | 2 | 2 | 5 | 1½ | II | Series interrupted. |
| 35th (Bartlett) | 12-inch Disappearing | 2730 | 2880 | 6 | 5 | 3 | — | 4 | 37½ | II | Series fired without interruption. |
| 41st (Landon) | 12-inch Mortar | 7100 | 7615 | 5½-8 | 5 | — | 1 | 19 | 0 | III | Series interrupted. |
| 58th (Barrette) | 12-inch Mortar | 7360 | 8520 | 6 | 5 | — | — | 10 | 0 | III | Series interrupted interfering vessels. |
| 69th (Hubbard) | 10-inch Disappearing | 3142 | 3900 | 8 | 5 | — | — | 4 | 36½ | II | Series interrupted. |
| 73rd (Fergusson) | 10-inch Disappearing | 3019 | 3250 | 8 | 5 | — | 5 | 4 | 4 | II | Series interrupted, third shot struck leading scow. |
| 118th (Pence) | 10-inch Disappearing | 4100 | 4300 | 8 | 5 | 1 | — | 4 | 42 | II | Series interrupted. |

The practice was with practice charges giving a M.V. of about 1300 f.s., which accounts for the short ranges used.



Artillery Practice, 58th Company, Coast Artillery. Battery Anderson, Fort Monroe, Va., April 16th, 1903. 12-inch B. L. Mortar, steel. Moving target.

The 13th Company and 35th Company, upon a day previous to the actual practice, fired each two trial shots corrected for drift and atmospheric conditions to test the powder. In the practice, the charges for the first three shots of each of these companies were of the same lot of powder as that used in the trial shots; the last two charges of each were of a different lot. In both cases the last two shots of each of these two companies went far beyond the target and were misses; the new powder evidently gave higher velocities than the older lot.

All companies firing, except the 118th and those using mortars, relied on the corrections determined by the trial shots, taking the proper elevations for the predicted ranges from the range table. The 118th Company corrected its elevations from the observation of fire.

The 35th Company used the chamber sponge after each round. This gun required 15 seconds to run into battery after tripping.

In the case of the mortars Brown Prismatic powder was used. No trial shots for velocity were fired, the performance of the powder of preceding year being the only guide. The results of the practice of the 58th Company is shown in the plate.

## ORGANIZATION AND ADMINISTRATION.

### The Defensive Organization of the French Coast.

A table annexed to the decree of February 17, 1894, divided the coast line of the French coasts into 19 sectors. In these the headquarters of the commanding officer were fixed at:

Dunkerque, Abbeville, le Havre, Cherbourg, St. Malo, St. Brieuc, Brest, Lorient, St. Nazaire, les Sables-d'Olonne, Rochefort, Royan, and Bayonne on the Atlantic coast; Perpignan, Cette, Marseille, Toulon, Antibes and Nice on the Mediterranean.

The coast of Corsica and that of Algeria-Tunis constituted two other sectors.

In case of mobilization, the maritime prefects exercised command, under the direct authority of the Minister of war, over all the elements pertaining to the Ministry of war, which co-operated in the guarding and immediate defense of the coast or the islands of their districts (arrondissements).

The commanding officers of the sectors are under the orders of the maritime prefects, except, however, those of the sectors the coast of which is contained in the perimeter of a fortified place other than a military port; that is to say, the sectors of Dunkerque, Bayonne, Perpignan and Nice and that of Marseille in so far as especially concerns the sea front of that city.

All the commanding officers of sectors are general officers of the navy except those of Dunkerque, Bayonne, Perpignan, Nice and Antibes, (where the safety of the railroad is of especial importance to the Army of the Alps), who are general officers of the army.

A general or field officer of the army is attached to the staff of the commanding officer of the sector when the latter belongs to the navy, and conversely.

The commanding officers of the sectors have under their orders:

The custom house officers of the coast brigades, and those of the mobilized active units; the troops of the army especially attached to the defense of the sector as soon as these elements of defense are constituted after mobilization; the means of the fixed defense dependent on the navy, and the floating defense of the district, when one of the points of the sector where these elements are stationed is menaced.

In case of attack, if the commanding officer of the sector judges that the troops under his orders are insufficient to repulse the attack, he informs the commanding officers of the neighboring sectors who send him the forces that they may be able to spare; if these forces are insufficient, the commanding officer of the threatened sector notifies the commanding officers of the neighboring subdivisions who then furnish him reinforcements.

In case these reinforcements exceed the effective strength of three battalions, the general commanding the region* assumes direction of the operations on land and the command of all land troops of the sectors of the region.

If circumstances require the presence of large organized units of the army, military authority assures the direction of operations by virture of a special order of the Minister of war.

A recent decision (February, 1903) of the Upper War Boards of the Army Navy combined (Conseils supérieurs de la Guerre et de la Marine) has still more increased the powers of the maritime prefects by giving them charge of the artillery of all the works fronting the sea along the coast of their district.

The following is a summary of this important decision as given by the *Moniteur de la Flotte*:

"In future, the navy will have control of the artillery of the coast batteries and of works facing the sea. The navy will hold its authority, in the premises, by virtue of a permanent delegation of authority from the Minister of war.

The vice-admirals, maritime prefects, who are governors of the military ports, headquarters of their command, will receive, accordingly, an extension of their powers in regards to the defense of the coast, and reserve officers of the navy will be attached to the coast batteries."

By the application of this decision there results that henceforth the maritime prefects *alone* will have the direction of operations directed against the enemy afloat and will retain authority over all the material afloat whether this material be stationed at any point whatever of the maritime district or in a port forming part of a military port placed under the authority of a special governor.

A naval officer will be stationed in all the coast batteries to serve as an intermediary between the commanding officers of the said batteries and the general officer to whom the maritime prefect will have given the command in chief of these batteries, in the case of fortifications placed under the direct authority of the maritime prefect; in the case of fortified places under a special governor, a ranking officer of the navy will be attached to the staff of the governor to represent the maritime-prefect, and he will have executed, after consultation with the governor, the orders he may recommend or receive from the maritime prefect for operations afloat.

The coast batteries will continue to be commanded by the officers and served by the artillery of the fortress artillery battalions, but to the staff of the commandant of each of the batteries there will be attached, as in Italy, a naval officer who will be competent to assist and enlighten him in those parts of his duties that are exclusively maritime, such as the identification of warships, friendly or hostile, signalling, transmission of information to receiving stations, etc.

As long as the enemy may not have effected a landing, unity of command will be realized then throughout the extent of the district of the maritime prefect; if the enemy succeeds in disembarking forces, in order to repulse which more than three battalions are necessary, unity of command disappears, because the direction of operations on land then pertains to the commanding officer of the region, the maritime authority continuing to make disposition of the floating means of defense. A special co-operation between the two Departments will be necessary in such a case in order to bring to bear in combination the full force of the land and sea elements of defense against the common adversary.

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* Military district of an army corps in time of peace; it has eight *subdivisions de region*, one to each infantry regiment of the corps.

This shows how delicate is the problem of bringing together the means of action of the two Departments concerned. Among the different elements of each, also, difficulties of almost the same kind exist. For example, for a long time the maritime mobile defense, which has a most important role in coast defense, pertained in each military port to the service of the submarine defense. The decree of April 1, 1902, has now caused the mobile defense to be an independent service directly under the orders of the maritime prefect.

Independently of the submarines now grouped at Cherbourg, Rochefort and Toulon, the mobile defenses are now constituted essentially of torpedo boats grouped by 6 to form a division, having as flagship a torpedo boat destroyer or a torpedo gunboat to serve as a scout for the division and to direct it in its attacks. Each division is subdivided into three sections and each section is composed of two torpedo boats commanded, one by an officer, the other, by a warrant officer. The divisions are stationed in time of peace at Dunkerque, Cherbourg, St. Servan, Brest, Lorient, Rochefort, Marseille, Toulon, Ajaccio, Bizerte, Alger and Oran.

—*Revue du Cercle Militaire*, April 4; *Armee et Marine*, March 8, 1903.

## WARSHIPS AND TORPEDO BOATS.

### Some New Types in the German Navy.

For the last forty years a steady increase in the size and efficiency of guns has produced a corresponding accumulation upon men-of-war of defensive armor plate, which, on its part, greatly improved in its protecting value as time went on. Both these changes tended to increase the weight and therefore the size of the ships, and a gradual growth of the displacement of battleships and cruisers is noticeable in the navies of all countries. A similar effect has been produced in the merchant service, by the demand for quick transport and long-distance traffic, the former necessitating considerable engine space and additional storage room for fuel, while the latter makes at any rate the second of these conditions necessary.

This increase is very clearly shown in the torpedo boats of the German fleet, whose displacement has risen from 85 to 350 tons within the last twenty years. The internal equipment, too, of the ships has undergone very marked changes, not only in the introduction of the use of electricity for a number of auxiliary machines and for other purposes, but also in the disposition of the guns and the mechanism for discharging torpedoes. The latter has been placed below the water line in the most recent German battleships H, J, K, L.

The battleship H launched in 1902 has a length of 398 feet 6 inches, and a beam of 73 feet 6 inches, with a calculated draft of 24½ feet and a displacement of 13,200 tons when fully equipped. It is by 2,050 tons larger than the boats of the "Kaiser" class. The three propellers are driven by three triple-expansion engines, which have a combined horse power of 16,000, producing a speed of 18 knots per hour. The requisite steam is raised in six cylindrical boilers and eight water-tube boilers of the Schulz type. The normal cargo of coal is 700 tons, the maximum cargo 1600 tons, and 200 tons of oil fuel can be carried in addition.

The armament of these ships is unusually heavy. It consists of:

1. Four 11-inch quick-firing guns of 40 calibers, mounted in revolving turrets.
2. Ten 6¾-inch guns of 40 calibers in the battery.
3. Four similar guns in revolving turrets.
4. Twelve 3½-inch guns of 35 calibers length on central pivot carriages (pattern 1889).
5. Twelve 1½-inch machine guns and eight ⅓-inch machine guns.

The heavy 11-inch guns stand in pairs in two armored turrets in front of the foremast and behind the mainmast respectively. The battery with ten 6¼-inch guns lies between the two turrets, but on the next lower deck and above the battery on the upper deck are placed the four smaller revolving turrets for the remaining four 6¾-inch guns.

The foremost and rearmost battery guns can also be fired dead ahead or dead astern. In the arrangement of smaller guns (3½ and 1½ inch) the chief object kept in view was to give them as large and as open a field as possible. The new ship H is capable of concentrating two 11-inch guns, four 6¼-inch guns, and six 3½-inch guns fore and aft, or four 11-inch guns, seven 6¼-inch guns and six 3½-inch guns on either broadside.

The armor plating, too, shows many improvements in the ships of the H class. The barbette and citadel armor is so combined with the barbettes of the heavy revolving turrets that there is no unprotected portion left between them. The central armor is reinforced and the conning tower and the barbettes of the revolving turrets have more than the usual protection. The water-line belt, 9 inches thick amidships, tapering to 4 inches at the ends, extends the full length of the ship, and above this the citadel armor 6 inches thick extends over three-fifths of the length. The turrets for the heavy guns are 10 inches thick; those for the secondary guns, 5½ inches thick. There are also two horizontal, slightly convex armored decks, of which the lower one is at the level of the lower limit of the belt armor, the upper one being above the water-line. The torpedo equipment in these battleships of the class H, just as in those of the "Kaiser" class and of the "Wittelsbach" class, consists of six torpedo tubes for 17¾-inch torpedoes, five of which are submerged.

The excellence of the new torpedo boats built in the "Germania" docks is well known. At their trial runs they made about 29 knots per hour, carrying their full equipment. Four of these have been built so far, two more being now building. These fast boats are 206 feet 8 inches long, have 23 feet beam, and 350 tons displacement. The two propellers are driven by engines indicating 5,400 horse power, and according to contract 26 or 27 knots per hour were to be attained. As stated above, the speed actually produced exceeded this. The armament consists of three 2-inch quick-firing guns, of which two are placed on either broadside in front of the conning tower, and the third is astern on the after conning tower. The torpedo equipment consists of three tubes of 17¾ inches diameter.

—*Scientific American Supplement*, March 28, 1903.

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# BOOK REVIEWS.

**A History of the Peninsular War. Charles Oman, M.A., Fellow of All Soul's College and Deputy-Professor of Modern History (Chichele) in the University of Oxford. Vol. I. 1807-1809. From the Treaty of Fontainebleau to the Battle of Corunna. Oxford: Clardeon Press. 1902. Pp. 656, with maps, plans and portraits.**

This is an entirely new work on this important epoch in history, free use being made therein of the enormous bulk of valuable material that has accumulated since Napier's day in English, French and Spanish, bearing on this period. Napier's work, which has held the field for sixty years, must still be regarded as a classic on the subject, and his vigorous prose descriptions will always remain as masterpieces in the English language, but Napier's was not an unprejudiced view, and in the light of public and private papers which have come to light in the past half century, as well as some recent histories presenting the Spanish side of the war, it is found to be extremely unreliable both as regards the Spanish Juntas and the Tory governments of 1808-1814.

Professor Oman, the author of the present work, has been working for some ten or fifteen years at the original sources, and has been impressed with the necessity for a new and more reliable history of the war, as a result ot his investigations. He soon became impressed with the feeling that Napier is not always a trustworthy guide:

"All his views are coloured by the fact that he was a bitter enemy of the Tories of his own day. The kinsman not only of Charles James Fox, but of Lord Edward Fitzgerald, he could never look with unprejudiced eyes on their political opponents. Canning and Spencer Perceval were in his ideas men capable of any folly, any gratuitous perversity. Castlereagh's splendid services to England are ignored: it would be impossible to discover from the pages of the *Peninsular War* that this was the man who picked out Wellington for the command in Spain, and kept him there in spite of all manner of opposition. Nor is this all: Napier was also one of those strange Englishmen who, notwithstanding all the evidence that lay before them, believed that Napoleon Bonaparte was a beneficent character, thwarted in his designs for the regeneration of Europe by the obstinate and narrow-minded opposition of the British Government. * * * * *

"On the other hand, Napier was just as over-hard to the Spaniards as he was over-lenient to Bonaparte."

The work opens with a discussion of the Treaty of Fontainebleau, and incidentally analyses Napoleon's character and designs. The Court of Spain is portrayed with a master hand, and, and the picture drawn remains indelibly impressed on the mind: the imbecile King, Charles IV, his Queen, "about the most unfit person in Europe to be placed on the throne at the side of such an imbecile husband", the incapable upstart Godoy, Prime Minister, and the heir to the throne, the weak Prince Ferdinand, are all presented in fine pen pictures, laying bare their characters with an unsparing hand.

The conquest of Portugal and the French aggressions in Spain follow rapidly, and then comes a vivid description of the outbreak of the Spanish Insurrection.

Before taking up the military operations, the author devotes a chapter to the military geography of the Peninsula, and the armies on the two sides (French and Spanish) and their tactics.

The first operations include the siege of Saragossa, the Battle of Medina de Rio Seco, and the capitulation of Baylen. The author's calm but impressive style may be judged of from the following extract of his description of the siege of Saragossa:

"All through the afternoon of the fourth of August, the French slowly pushed their way up the streets which lead northward towards the Coso, the main thoroughfare of Saragossa. They could only get forward by storming each house, and turning each barricade that offered resistance, so that their progress was very slow. While inflicting terrible losses on the Spaniards, they were also suffering heavily themselves. But they drove a broad wedge into the city, till finally they reached and crossed the Coso, halfway between the southern wall and the river. In the streets beyond the Coso their impetus seemed to have exhausted itself: many of the men were too tired to press forward any longer; others turned aside to plunder the churches and the better sort of houses. Verdier tried to cut his way to the great bridge, so as to divide the defenders into two separate bodies, and was so far successful that many of the Spaniards began to troop off across the river into the suburb of San Lazaro. But he himself was wounded, his main column lost its way in the narrow side-streets, and the attack died down."

"In the late afternoon there was almost a suspension of hostilities, and the firing slackened for a space. But at last the Aragonese, encouraged by the exhaustion of their enemies, began to resume the offensive. * * *
The fighting was of that deadly sort in which the question has to be settled, whether the defenders of the houses in a street can shoot down their assailants, exposed in the roadway, before the latter can burst into each separate dwelling and exterminate its garrison in detail. Often the French held the upper stories long after the Spaniards had seized the ground floor, and the staircases had to be stormed one after the other."

The story then takes up the succession of events, treating them in great detail: the outbreak of the Portuguese Insurrection, followed by the landing of the British and the evacuation of Portugal by the French; the struggle in Catalonia and the French retreat to the Ebro; the arrival of Napoleon and his rapid advance to Madrid; and finally the campaign of Sir John Moore, which closes the first volume.

The maps are excellent, their topographical details having been drawn from the splendid atlas published by the Spanish War Office during the last twenty years.

There is an appendix containing many valuable papers and lists, and a good index.

The entire work will be a notable addition to general and military history, and constitutes an excellent study in state policy, strategy and tactics.

J. P. W.

**The Principles of Land Defence and Their Application to the Conditions of To day. Captain H. F. Thuillier, Royal Engineers. New York: Longsman, Green & Co. 1902. Pp. 384.**

The work before us is unquestionably the most advanced in its ideas and principles of any that has recently been published. It deals particularly with the *tactics* of the employment of fortifications on land, and its modern character is at once evinced by the statement in the Preface that "a knowledge of the correct tactical disposition and employment of defensive works is a necessity for every soldier. It is the general custom in English military teaching to make a broad distinction between Field Fortification and Permanent Fortification, and to consider the former as a subject to be understood by all branches, and the latter to be an abstruse science confined to the technical branches. This is wrong; the two are the same in principle, and, though works of the one nature have to be executed by the troops themselves, while those of the other are constructed under the superintendence of technical experts, yet the design and disposition of either lie entirely within the domain of the practical soldier, and a knowledge of the principles is as important a part of military education as any other branch of the warlike art".

Similar opinions have quite recently been expressed by a number of tacticians in various countries, especially by field artillery officers. All seem to appreciate that this subject is no longer the particular province of the technical troops (artillery, engineers or pioneers), but is the public property of the army at large.

After discussing the relation of fortification to strategy, national defense and tactics, the author states the two great principles at its foundation, applying at all times and to all weapons. The early forms and the changes brought about by improvements in weapons are next considered, leading up to the third principle of fortification.

The causes of success and failure in various sieges are discussed, illustrated by the wars of Marlborough and Eugène, the Peninsular War and Sebastopol. Coming down to more recent times the, Franco-German seiges, and Plevna receive considerable attention.

In the American Civil War the sieges of Fort Fisher and Vicksburg are used in illustration, and then the more recent developments in fortification are taken up—the Trydall Redoubt and the views of Sir G. Clarke.

The most important part of the work is comprised in the last few chapters (covering, however, about one-half of the book), in which are treated the high explosive shell, smokeless powder, magazine rifle fire and the new element of concealment of defensive works. The illustrations are taken largely from the Boer war, and the lessons are summed up in the probable mode of attack of the future.

The tactical organization of fortified positions of the present day is fully discussed from all points of view. It is interesting to note that in calculating the *infantry* garrison required for a fortified position, the author lays down the rule that about two men for every yard of front will be sufficient, and this will provide for firing line, supports, reserves and losses due to disease and the enemy's fire; while the *artillery* garrison must be about thirty men for every medium and heavy gun and eighteen for each light piece. The strength of infantry required is based on the number of yards of parapet which may be attacked simultaneously, not on the entire perimeter of the place.

The work concludes with an appendix containing Major-General Baden-Powell's Report on the Siege of Mafeking.

The book is well illustrated, and its subject-matter is new and original. It is without doubt the most important work on the subject of which it treats that has appeared in the last quarter of a century.

J. P. W.

**Militaer-Lexikon, Handwoerterbuch der Militaerwissenschaften. H. Frobenius. 1901. Berlin: Martin Oldenbourg, Pp. 920. (Supplement I, pp. 52).**

This is the most recent and one of the best military dictionaries published; it is certainly the best in the German language. It is a successor to Scheibert's *Illustrirter Deutscher Militär Lexikon.* The principal assistants of Scheibert (Major-Generals Wille and von Zeppelin) were also Frobenius' assistants, but their articles in the older work were entirely rewritten for the new one. All other articles are entirely new.

In order not to become obsolete in part before it was completed the dictionary had to be written rapidly, so that errors necessarily resulted, such as the omission of the *scale* from a few of the maps. But on the whole the work is remarkably free from grave errors or omissions.

In the historical notices the author wisely decided to go back no farther than the Thirty Year's War, and to limit himself to what is important in a military sense.

There are 513 illustrations in the text, 5 charts giving the present stations of the troops of the great armies: Germany, France, Russia, Austria and Italy, and a complete table of the world's rapid-fire guns.

Many of the articles are very comprehensive, for example, that on Military History and that on Military Literature, the former covering eighty pages, the latter thirty. The work is particularly rich in plans of battles, and the *tactical* element is very prominent throughout the book. The war material illustrated is entirely modern, and in general, the very latest.

The supplement contains even more recent words and data. The principal additions are the various forms of automatic pistols (fully illustrated), the latest organization of the U. S. army and navy, of the Spanish and Turkey army as well as a number of others, together with the recent changes in all; the new Machine Gun Companies of Switzerland (illustrated), the fortification works at Gibraltar, the new German siege gun and mortar, and Schneider-Canet's double guns of heavy calibre.

It is impossible to give a clear idea of the salient points of this excellent military dictionary without making extracts of the parts illustrating them, and that would take up too much space. Suffice it to say that the system and arrangement are excellent, and the cross references leave nothing to be desired. The object of the editor, to include only what is important in a military and a modern sense, has been accomplished, and the work is typical of the useful dictionary for the military student of to-day, without going into technical details or the nomenclature of small parts of war material.

A really good military dictionary in small compass is very rare in any language, but perhaps the best and most complete are the French. In the English language there is no good modern one. The work entailed in compiling a dictionary is stupendous. and the return in case of a *military* dictionary is comparatively small; indeed, except in the great armies of Europe, such work is very apt to be largely a labor of love. Moreover, war material changes rapidly and military dictionaries soon become obsolete. For these reasons they should always be judged charitably.

The work before us, however, is really satisfactory and useful, and should find a place in every library.

J. P. W.

**The Despatches of Field-Marshal The Duke of Wellington, During his Campaigns in India, Denmark, Portugal, Spain, The Low Countries, and France, and relating to America, from 1799 to 1815. Selected and Arranged by Walter Wood. New York: E. P. Dutton & Co. London: Grant Richards. 1902. Pp. xxxi+475. O. With Index. Green cloth. $3.50 net.**

This work is an important and highly interesting volume consisting of selections from the despatches and documents relating to the campaigns of one of England's and the world's greatest and most successful generals.

On the famous despatches themselves, it is unnecessary to make comment here. But the original monumental compilation of His Grace's general orders and despatches made by Lieutenant-Colonel Gurwood, many years private secretary to the Duke, which forms a large series of twelve bulky volumes, contains great numbers of documents which have little or no present-day interest, and it is not all officers who may be able to possess such a library. Hence the value of the present work, containing as it does in one volume, a judicious and well-arranged selection of the entire collection, is evident.

Mr. Wood calls his book an epitome of the work compiled by Colonel Gurwood. His plan has been to select the papers in such a manner that they present the Duke of Wellington "as the historian of his own brilliant career." "My task has been to choose the most interesting passages, to give them headings, and to bring together some of them--as in the case of those relating to America--from several volumes, for convenience of reference, so that they may tell their own story of the unparalleled achievements of our greatest soldier."

The selections have been wisely and happily made, the arrangement is most satisfactory, and, as a result, the book furnishes an interesting and valuable condensed history of the career of this great soldier.

Wellington's early military life is described in the despatches from India, and the selections relating to the Peninsula give a picture, plain and striking, of the long years of battle and suffering by that matchless army of which the Duke proudly said that he thought he could have gone anywhere and done anything with with it. The wonderful series of victories beginning with Roleia and ending with Waterloo are described and the documents furnish a story which needs no embellishment or help.

The selections cover an amazing variety of subjects. They show fully the work which Wellington accomplished and the means by which he did it. Stern work it was, and stern measures were necessary, but it was only by his iron rule that the Duke was able to bring his troops triumphant out of unexampled dangers.

**Taschenbuch der Kriegsflotten. 1903. By B. Weyer, Kapitan-leutnant a. D. München: Verlag von J. F. Lehman. Pp. 321. S. With 277 pictures and plans of ships. Blue Cloth. Mk. 3.**

This, the 4th year, of the Pocket-book of War Navies appears in attractive form, containing many new features. For its size and price, it appears to us one of the most satisfactory of the naval annuals.

It consists of five parts: In the first is given a list of warships of all nations arranged in tables which give all desired information. These are supplemented by the plans and photographs of ships, which are all of a uniform scale 1:1500, and are particularly good. The system of indicating the armor protection instantly appeals to the eye and the photographs might well serve for identification purposes.

The second part contains much statistical information concisely given. It consists essentially of a comparison of the navies of the Powers; their strength, budgets; ships building and to be built, and future programs. In some cases the figures given differ from those of other authorities, but we find this to be the case in many instances in different authorities on naval matters, hence it cannot be considerd a criticism against the present work.

The third part treats of the naval artillery of the various nations; the fourth gives miscellaneous information on the German fleet and naval establishment, and the fifth includes conversion tables, distance tables, etc.

The lists of ships and the plans and pictures form the most important part of the book and they will be found most satisfactory for ready reference. The lists are well arranged and give data of the various ships fully yet in concise form. This little book will, we feel sure, meet with even greater favor than before and will prove a handy, useful work to all interested in naval matters.

**Regimemtal Duties Made Easy. By Major S. T. Banning, 1st Bn. Royal Munster Fusiliers. Second Edition: Revised. London: Gale & Polden, Ltd. 1902. Pp. xii+161. D. Five Shillings.**

Many changes have taken place of late in England in military administration affecting regimental duties, and in response to the demand, Major Banning has furnished a carefully revised edition of this excellent book. It forms a well-arranged compendium of the various matters which constitute the subject "A" for promotion examinations, but it also has a value as a concise guide to the ordinary routine work which an officer is called upon to perform in the English service.

The regulations bearing on these subjects and other sources from which officers should obtain their knowledge are quoted, and explanations given where necessary. Major Banning is well known and his experience as an instructor has enabled him to present a clear and intelligible view of the subject, affording the student just what he requires, and thus making it easy for him to grasp the essential facts.

The work is undoubtedly a handy and complete guide to the subject and should prove of considerable interest to those concerned.

**The Non-commissioned Officer's Guide to Promotion in the Infantry. Lance Corporal to Corporal and Corporal to Sergeant: New Edition. London: Gale & Polden, Ltd. 1903. Pp. xvi+277. D. Three-and-Six.**

This book is intended as a handbook containing all the subjects in which candidates are required to pass in the compulsory professional examinations for non-commissioned officers before promotion.

It contains the actual text of each subject in the fullest detail (contained in a great number of official military books) and also questions and answers on each of those subjects by which candidates can readily test their knowledge thereof.

While intended for the British service, the book also contains much information of general interest to the student interested in military systems.

It will be found a convenient and practical aid amply fulfilling the necessary requirements.

**The International Encyclopaedia. Editors: D. C. Gilman, LL.D., President of Johns Hopkins University; H. T. Peck, Ph. D., L. H. D., Professor in Columbia University; F. M. Colby, M. A., late Professor of Economics in New York University. New York: Dodd, Mead and Company. 1903. Volume VI.**

The sixth volume of this work carries it nearly through the letter E, and is quite equal in excellence of character and design to the preceding volumes. It contains a number of very important articles, such as electricity (which is treated most satisfactorily), Electric Lighting. Electric Railways, Dynamo-Electric Machinery, Dictionary, Encyclopædia, Education, England, English Literature, Egypt, Egyptian Art, Drama, Engineering Instruments, Digestion, Embryology and Electro-chemistry, all of which are extensively treated, and most of them generously illustrated.

There are five colored plates, beautiful specimens, relating to Dragon Flies, Domestic Ducks, and the Eggs of American Song Birds and American Game and Water Birds. The maps are of England, Egypt, Ecuador, and the East India Islands.

The engravings are more numerous than usual, numbering forty-three in this volume, and include such works of art as *The Magdalen*, of Carlo Dolci, *St. George*, by Donatello, George Dow's *Portrait* of Himself, Albert Dürer's *Portrait* of Hieronymus Holtzschuer in the Berlin National Gallery, the *Temple of Horns* at Edfu, Durham Cathedral, Temple at Philæ, Colossal Statue of Rameses II, Elephanta (temples at Bombay Harbor, India), Queen Elizabeth, Dürer's *Adoration of the Magi*, and the *Erectheum*.

The special feature of the longer and more important articles is the Bibliography, which is very satisfactory, being complete, up-to-date and selected with good judgment.

There is one element of this Encylopædia, to which we have not before referred, namely the *Key to Pronunciation*. This is all contained on one page and is very simple and sufficient. Greater details are to be given in the article on *Pronunciation*.

The purely military articles in this volume (aside from the numerous biographical, historical and geographical articles including much military material) are: Ditch, Battle of Dresden, Drill, Drill Regulations, Drum, Dum-Dum Bullet, Dummer's War, Dunmore's War, Dynamite, Dynamite Gun, Dynamite Cruiser, Earthworks, East India Army, Echelon, Eckmühl, Epaulet, Ensign, El Caney, Encampment Enfield Rifle, Engagement, Engineer Corps, Military Engineering, Enlistment, Battle of Lake Erie and Esopus War.

The mere enumeration of these indicates the variety of matter contained in the Encyclopædia, as well as the completeness of treatment of military subjects. There are many other articles of general interest to the military man, for example, one on *Driving*, which is well illustrated, showing the proper way to hold the reins.

This volume, like its predecessors, is most satisfactory in the mode of treatment of the subjects, in the illustrations and in the bibliography, and preserves the reputation of the entire work as a reliable adequate and superior work of reference.

J. P. W.

## EXCHANGE AND BOOK NOTICES.

[Books received will be *reviewed* as space becomes available].

**The Naval Annual, 1903.** Edited by T. A. Brassey. Portsmouth: J. Griffin and Co., 2, The Hard. Pp. 453. O.

**Organization and Equipment Made Easy.** By Major S. T. Banning, 1st Bn. Royal Munster Fusiliers. 3rd Edition. Revised to date. London: Gale & Polden, Ltd. 1903. Pp. 140. D. Four-and-Six.

**Die Bein und Hufleiden der Pferde.** By Oberst Spohr. 7th Edition, enlarged. Leipzig: Arwed Strauch. 1903. Pp. xviii+198. O. Paper. Mk. 2.

**Notes on Kit for West Africa, by Captain H A. Thorne, of the West African regiment, will be found full of useful hints and recommendations regarding what to wear and to take out with one on going to such stations as West Africa or similar climates, made by one who has had long experience of "the Coast."**

**Physical Drill with arms Made Easy and New Bayonet Fighting** is a little book of Gale & Polden's Military Series, which gives some excellent examples of physical drill for the purpose of setting-up the soldier, developing one's muscles and activity, and quickening the intelligence. It is fully illustrated by well-drawn plates and thus enables one to follow readily the motions and positions in practicing the various exercises.

**The Scouts' Alphabet of Notes and Queries will be found a useful and** handy book of reference by cyclists, mounted infantry and others who may be sent hurriedly to collect information. It is arranged alphabetically, for example, FARM, FERRY, FORD, FOREST, etc., and on the left hand page are concise notes while on the opposite page are the points about which information should be obtained as a result of the reconnaissance. Hence a momentary reference to it may prevent important points being missed.

We have also received from Messrs. Gale & Polden, Ltd., London, the following:

**"Telling off" and "Posting" a Picquet** with Notes on Outpost Duty and Advanced Guard for a company. Sixpence.

**Tactics Made Easy for Non-Commissioned Officers and Men,** by Colonel H. D. Hutchinson. Sixpence.

**Catch Questions in Infantry Training.** Sixpence.

**Aids to Skirmishing,** in accordance with Infantry Training, 1902. Sixpence.

**The Soldier's Pocket Manual of Useful Information,** by Major S. T. Banning. Ninepence.

**Index de la Presse Technique. No. 1. April, 1903. Engineering.**

With a view of systematizing information of all kinds regarding the sciences and technical matters in general, the **Association de la Presse Technique** commences with this issue a series of **Indices** giving the title with brief explanation, the name of the author, the origin, the date of publication and the length of the articles of general interest appearing in the principal journals of the technical press throughout the world.

The practical utility of such an undertaking cannot but be admitted, and when carried out with such attention to detail as is evidenced in this first issue, its value and importance will, we feel sure, be appreciated, and the **Index** itself meet with wide acceptance and approval.

The three principal languages are used in indexing : English, French and German ; French being used for all languages of Latin origin, including Russian, and German including Scandinavian and Dutch. The entries are succinctly resumed, and classified according to the Decimal Classification employed by the International Office of Bibliography (Brussels), the class number of each being given at the upper right hand corner. Further, the entries are printed on one side of the page only, hence they can be readily cut out, pasted on cards, and the specialist has then at hand a ready reference to all that appears in the technical press regarding his branch.

The Association also undertakes to supply subscribers with cuttings of the majority of the articles indexed, and also with the entries on cards, at reasonable rates.

This brief summary will suffice to show the scope and value of the work. The **Index** can be obtained from the **Association de la Presse Technique, 69 Rue du Nord, Bruxelles,** subscription price 4 shillings per year.

We can cordially commend the **Index** and our best wishes are extended to the Association for the successful issue of their enterprise.

# INDEX TO CURRENT MILITARY LITERATURE.

[For Abbreviations used in Index see first number of each *volume*.]

[Periodicals of January, February, March, April, 1903.]

## ARTILLERY MATERIAL.

The American 16-inch gun,—**A. Marine,** February 22.

Shields for field artillery. **Armee,** February 6; **S. M. Blaetter,** February.

Field gun questions (shields, etc.,).—**M. Gids.,** 3, 1903.

Artillery questions.—**Int. Rev.,** Supplement 48.

On the German field gun question.—**S. M. Blaetter,** February.

On the gun question (armored field artillery or not?).—**S. M. Blaetter,** February, March.

New sights for field guns (sights with levels and telescopic sights).—**R. M. Suisse,** February.

The year's experiments with shields on field guns in Germany.—**N. Art. Tids.,** 5, 1902.

Field and position artillery, Schneider and Co., and firing experiments therewith at Harfleur, March 1901.—**Art. Tids.,** 5 and 6, 1902.

The field gun question, (Germany.—**Umschau.,** March 14.

Transformation of field artillery material amongst the various Nations.—**R. M. Etrang.,** March.

Shrapnel *vs.* explosive shell.—**Wochenblatt,** March 7, 11, 14; 18.

In explanation of recoiling guns and armor.—**Wochenblatt,** February 4, 7, 21; **Jahrbucher,** March.

Rapid-fire field material.—**M. de Art.,** February.

Modern field artillery.—**M. de Art.,** February.

Observation ladders for light howitzer batteries.—**Int. Rev.,** Supplement 47.

Rearmament of field artillery (field guns adopted or to be adopted by various nations).—**Int. Rev.,** Supplement 49.

The question of field howitzers in Germany. **Proc. R. A. I.,** February.

Field guns of the Skoda works.—**Mitth. Art. u. G.,** April.

Question of shields for field artillery.—**Ueberall,** 29, 1903.

The German mountain artillery in China.—**Wochenblatt,** April 1.

New field guns or not?—**Kriegstech.,** 2, 1903.

Maxim machine gun and its use.—**N. Art. Tids.,** 6, 1902.

Maxims in warships (its utility).—**Eng.,** April 3.

Hotchkiss 1.1 cm. automatic machine gun.—**S. M. Blaetter,** March.

Machine guns.—**Exercito,** March.

Test of a new automatic gun.—**Compr. Air,** March.

Artillery at the Dusseldorf exposition. **R. Artillerie,** February, March, April.

Guns and armor.—**R. Marit. Brazil,** January.

Armor and artillery. **N. Art. Tids.,** 6, 1902.

A new sighting gear for naval guns and gunnery signalling apparatus.—**Scien. Amer.,** March 28.

Triumph of the capped shot over armor.—**U. S. Gaz.,** March 21.

Cockerill Company's resistance trials of steels for guns.—**A. Belge,** January-February.

Comparison of various tests of paints for the protection of iron.—**Tech. Quart.**, March.

The Hotchkiss Ordnance Co., Limited (description of guns, etc.,).—**Eng'ing.**, March 13, 20; April 3.

Armor-piercing projectiles.—**U. S. Gaz.**, March 7.

Stowage of the larger calibres of fixed ammunition.—**Naval Inst.**, March.

War material, 1902. -**Eng.**, January 2.

Classes of powders and their application in war.—**M. de Art.**, January, February.

Explosive power of certain explosives.—**N. Art. Tids.**, 5, 1902.

The dangers of nitroglycerine.—**Eng.**, April 17.

An adjustable fuze scale.—**Proc. R. A. I.**, October-December, 1902.

A rustic telemeter.—**Proc. R. A. I.**, January.

Sorenson range finder.—**West. Elec.**, March 21.

Grenfell sighting device.—**U. S. Gaz.**, April 11.

A telescope for field artillery.—**Proc. R. A. I.**, October-December, 1902.

## AUTOMOBILES, BICYCLES, AEROSTATION.

The dynamics of free balloons.—**Genie M.**, February, April.

On attempts made to solve the problem of aerial navigation.—**Zeitsch. I. A. V.**, April 10.

Electricity as a motive power in mechanical flight.—**Elec. World**, March 14.

New observation kites invented by S. F. Cody.—**Scien. Amer.**, Supplement, April 11.

Automatic discharge of ballast for free balloons.—**Scien. Amer.**, Supplement, April 11.

The Stanley airship.—**Scien. Amer.**, May 2.

Some 1903 models of automobiles. -**Scien. Amer.**, April 11.

Latest types of motor bicycles.—**Scien. Amer.**, April 11.

The automobile in warfare.—**Scien. Amer.**, April 11.

The automobile wagon of 1902.—**Genie C.**, February 28, March 7.

The automobile for the use of armies.—**S. M. Blaetter**, February.

Mechanical traction and its application to military transport.—**R. M. Suisse**, February, March, April.

Crystal palace motor-car show.—**Eng'ing.**, March 6.

Motor-cars.—**Eng'ing.**, April 3.

New steam motor-car.—**Eng.**, March 13.

Military motor lorries.—**Eng'ing.**, April 10.

Results of tests of alcohol motors in Germany.—**Scien. Amer.**, Supplement, April 25.

Oil motor cars of 1902.—**Proc. I. M. E.**, October-November, 1902.

Touring bicycles.—**Genie C.**, March 14.

Bicycles, recent novelties. - **Genie C.**, March 21, 28.

## BALLISTICS.

Sound phenomena of projectiles from weapons with great initial velocity.—**Wochenblatt**, February 14.

Extracts from "Exterior Ballistics."—**R. Mil. Brazil**, March.

Photographic determination of the progressive and rotary velocity of projectiles at the end of the trajectory.—**Kriegstech.**, 2, 1903.

Short study on the rifling of guns.—**M. de Art.**, January, February.

Ballistic apparatus.—**Mitth. Art. u. G.**, February, March.

Study on the phenomena of erosion produced by explosives.—**M. Poudres**, vol. xi., 3 and 4.

Correction of range tables for the condition of the powder.—**M. de Art.**, February.

Some experiments on erosion.—**Arms and Expl.**, April; **A. and N. Jour.**, Nay 9.

Tests of armor plates, Vickers Sons and Maxim.—**Eng'ing.**, March 13.

## CHEMISTRY AND PHOTOGRAPHY.

Combustion and combustibles.—**R. de Mar.**, January, February.

Electro-chemistry.—**Zeitschr. I. A. V.**, March 20.

The emanations of radium.—**West. Elec.**, April 25.

The gum-bichromate photo-printing process.—**Scien. Amer.**, Supplement, April 25.

Sigriste apparatus for instantaneous photography.—**Cercle**, April 11.

Application of long distance photography in the siege of Paris.—**Wochenblatt**, April 18.

Control in the gradation of the negative.—**Photo. Jour.**, March.

Photo-micography in black and white and in colors.—**Photo. Jour.**, March.

## DRILL REGULATIONS, MANEUVERS AND PRACTICE.

New combined training and infantry training, British army.—**R. M. Etrang.**, February, March, April.

New French provisional regulations on instruction in infantry fire.—**A. S. M. Zeit.**, February 14, 21, 28; **Cercle**, February 21, 28; **Wochenblatt**, February 28.

Draft of regulations for machine gun groups, German army.—**R. Univ.**, March, April.

Shooting and hitting; an infantry study.—**Kriegstech.**, 3, 1903.

The true training of troops.—**A. and N. Gaz.**, April 18.

Drill regulations for English infantry, 1902.—**R. M. Suisse**, April.

The importance of drill and its limits.—**Int. Rev.**, Supplement, 49.

The Roumanian army and its recent grand maneuvers.—**A. S. M. Zeit.**, March 28.

Regulations for mounted artillery.—**Exercito**, March.

A new French drill regulations for infantry.—**Wochenblatt**, April 7.

The training of the army.—**Jour. R. U. S. I.**, February.

October mobilization and maneuvers in Spain.—**Ueberall**, No. 20, 22, 1903.

The Imperial maneuvers in western Hungary, 1902.—**Int. Rev.**, Beiheft 38.

Maneuvers of the IV. army corps, 1902.—**Beilage, A. S. M. Zeit.**, 1, 1903.

The artillery during the field operations in Sweden, 1902.—**Art. Tids.**, 5 and 6, 1902.

Report of practice during the year 1901.—**Art. Tids.** 5 and 6, 1902.

Maneuvers of the 35th French infantry division in the autumn of 1902.—**Int. Rev.**, Beiheft, 37.

Russian grand maneuvers, 1902.—**Armee**, March 20.

Maneuver tactics and maneuver grounds.—**Jahrbucher**, March.

Imperial German maneuvers; charges executed by large masses of cavalry against troops or other arms.—**Int. Rev.**, Supplement 47.

Garrison maneuvers.—**Belgique M.**, April 5.

The army and navy maneuvers as viewed from afloat.—**Jour. M. S. I.**, May-June.

Portugal: the maneuvers of the 1st division.—**R. Inf.**, March.

Experiments on snow, in Italy, (parapets of snow and firings against them by infantry and artillery, marches on snow and bivouacs).—**R. Inf.**, April.

Imperial German maneuvers, 1902.—**R. M. Etrang.**, April.

Combined army and navy maneuvers, U. S.—**R. Maritime**, March.

Thoughts on naval evolutions and maneuvers.—**R. Marit. Brazil**, January.

Naval maneuvers in the Caribbean Sea.—**R. Maritime**, March.

English fleet maneuvers, 1902.—**Ueberall**, 29, 30, 1903.

Target practice at Pensacola (navy).—**A. and N. Jour.**, April 25.

Naval gunnery—international comparisons.—**Eng.**, April 17.

## ELECTRICITY.

Wireless telegraphy in field service.—**S. M. Blaetter**, February.

Main electric railway lines.—**Mitth. Art. u. G.**, February.

Loud speaking telephones, Siemens Halske make.—**R. G. de Marina**, March.

The development of wireless telegraphy.—**Seewesens**, 3, 4, 1903.

Movable stations for wireless telegraphy in the German army.—**Umschau**, March 7.

Hertzian wave telegraphy.—**R. Marit. Brazil**, February, March.

Wireless telegraphy.—**Pages Mag.**, April; **Eng.**, March 6, 13, 20; **Mitth. Art. u. G.**, March.

Military telephony and telegraphy in the German army.—**West. Elec.**, March 28.

Latest types of telephone instruments.—**West. Elec.**, March 28.

The receiving apparatus for wireless telegraphy.—**R. Artig.**, January.

Development of Marconi's wireless telegraphy.—**Scien. Amer.**, Supplement, April 25, May 2.

Recent experiments in wireless telegraphy.—**Genie M.**, April.

The typewriting telegraph for artillery purposes.—**Proc. R. A. I.**, October-December 1902.

Kleinschmidt facsimile telegraph.—**West. Elec.**, March 14.

Lodge-Muirhead-wireless-telegraph system.—**West. Elec.**, April 18; **Scien. Amer.**, April 18.

Wheatstone-bridge telephone system.—**West. Elec.**, April 18.

The designing of telephone apparatus.—**Elec. Rev.**, April 11, 18, 25.

De Forest wireless telegraph system.—**Elec. World**, April 11.

Construction of aerial telephone lines.—**Elec. World**, April 4, 11.

Telegraph engineering in the Philippines.—**Eng'ing. Mag.**, May.

General specifications for the construction of telephone aerial lines.—**Elec. World**, April 25.

Electrical power transmission.—**Zeitsch. I. A. V.**, March 20.

Electrical installations in armored forts.—**A. Belge**, January-February.

Hertzian wave telegraphy.—**Eng'ing.**, March 6, 13, 20, 27.

Electric lighting of quarters of regiment of engineers.—**Eng. Mil.**, January.

Electricity in its application to submarine mines.—**Eng. Mil.**, February.

Switchboard construction for isolated plants.—**Scien. and Indus.**, April.

The incandescent lamp filament.—**Scien. and Indus.**, April.

Some facts about electric cables.—**West. Elec.**, April 4.

The Heyland induction motor.—**Elec. World**, March 14, 21.

Development and use of the small electric motor.—**Eng'ing. Mag.**, April, May.

Alternating current for light and power.—**Cas. Mag.**, April.

Edison storage battery improvements.—**West. Elec.**, March 14; **Elec. Rev.**, April 25.

Unique German storage battery.—**West. Elec.**, March 21.

The electrolytic rectifier.—**West. Elec.**, March 21.

Electrolytic apparatus for rectifying alternate currents.—**Elec. Rev.**, 14.

Westinghouse turbo-generators.—**Elec. World**, April 18.

Hints on the care and paralleling of direct-current dynamos.—**Amer. Elec.**, April.

Silvey storage batterios.—**West. Elec.**, April 11.

Shunt field and variable voltage control for electric motors.—**Amer. Mach.**, April 30.

The Tribelhorn accumulator.—**Genie C.**, April 11.

### ENGINEERING AND FORTIFICATIONS.

Armored concrete.—**Stahl u. Eisen**, February 15; March 1, 15.

Metal bridges.—**Memoires I. C.**, January.

Manufacture of cement from marl and clay.—**Eng. C.**, Philadelphia, April.

Protection and preservation of wood.—**Eng. C.**, Philadelpia, April.

Modern machinery for excavating and dredging.—**Eng'ing. Mag.**, April.

New automatic level rod.—**Eng'ing. News**, March 12.

Stadia lines.—**Eng'ing.**, April 17.

A mode of revetment for damp places.—**Genie C.**, February 28.

Enlargement of Antwerp.—**A. Belge**, January-February.

Construction of Roman camps at Lambessa, North Africa.—**Scien. Amer.**, Supplement, April 25.

Use of mines in the attack and defense of forts.—**Eng. Mil.**, February.

Revetments of *Rubberoid* in fort D. Carlos I.—**Eng. Mil.**, February.

Two types of intrenchments for rapid-fire guns.—**Sbornik**, 3, 1903.

### ENGINES, BOILERS AND MECHANISM.

Best methods of feeding boilers.—**Amer. Manf.**, April 2.

Berg boiler feed regulator.—**Amer. Manf.**, April 2.

Boiler accessories.—**Amer. Elec.**, April.

Collapse of furnace crowns.—**Amer. Manf.**, April 30.

Fuel economy and boiler efficiencies.—**Eng'ing.**, April 17.

The new Westinghouse gas engine.—**Amer. Elec.**, March.

Development of gas engines.—**Scien. and Indus.**, March.

Theory of operation of the gasoline engine.—**Eng. Soc.**, February.

Compound gas engine.—**Iron Age**, March 19.

New internal combustion engine.—**Eng. Cleve.**, March 16.

An application of gas engines to isolated plant work.—**Amer. Elec.**, April.

Theory of the gas turbine.—**Eng. Cleve.**, April 15.

A remarkable English engine.—**Amer. Elec.**, April.

Curves representing the adiabatic expansion of steam.—**Eng.**, April 10.

Modern development of the steam turbine.—**Scien. Amer.**, April 25.

Oil-cooled gasoline engines.—**Scien. Amer.**, Supplement, April 25.

The modern power problem.—**Cas. Mag.**, March, April.

Steam consumption of engines.—**Scien. and Indus.**, April.

Curtis steam turbine.—**West. Elec.**, April 18; **Elec. World**, April 11; **Elec. Rev.**, April 11.

Indicating high-speed engines.—**Eng.**, March 6.

The slip of belts.—**Eng.**, April 3.

## METALLURGY.

Present state of the iron and steel industries in the provinces of the Rhine and Westphalia.—**Memoires I. C.**, January.

Determination of carbon in steels.—**M. de Art.**, January.

Present state of our knowledge of the constitution of carbon steels.—**Genie C.**, April 4, 11.

Aluminothermie.—**R, Artig.**, January.

Steel for projectiles,—**R. Artig.**, February, March.

Methods of test of metals by means of small notched bars.—**R. Artillerie**, April.

Watertown arsenal tests of metals.—**Iron Age**, March 19.

Bessemer steel, basic and acid processes, with analysis and physical tests. —**Eng. Cleve.**, March 16.

Electrical manufacture of steel in Sweden.—**Elec. World**, April 4.

## MILITARY GEOGRAPHY.

Sebastopol.—**A. Marine**, March 8.

The harbor of Swakopmund.—**Ueberall**, No. 22, 1903.

A new English military port on the North sea.—**Ueberall**, 26, 1903.

Kampot.—**A. Marine**, March 29.

The Congo.—**R. Maritt**, February.

The military importance of Hong Kong.—**Wochenblatt**, April 9, 11.

## MILITARY HISTORY.

The movements of the army in 1870-71 and their lessons.—**R. M. Etrang**, February, March.

Studies on the South African war.—**R. M. Etrang**, February, March, April.

Contact battle and pre-arranged battle; historical study.—**Armee**, February 6.

Maps for the study of military history.—**Armee**, February 20.

The block-house system in South Africa.—**Armee**, February 20.

The train and its importance in wars.—**Ueberall**, No. 22. 1903.

Ziethen's 1st army corps at La Belle Alliance and Wavre.—**Jahrbucher**, February.

Military history and infantry tactics.—**Jarhbucher**, February.

The operations of Suworoff against Moreau and Macdonald.—**S. M. Blaetter**, February, March.

Napoleon, the chief of the army.—**Cientifico**, January 1, 15; February 1, 15; March 1.

Notes on artillery in the South African war.—**R. M. Suisse**, February.

Russia's preparations for war and the movements of her army in 1877, until the first battle of Plevna.—**Bieheft zum M. W.**, 2, 1903.

Movements of the South German army in the main campaign, 1866.—**Bieheft zum M. W.**, 2, 1903.

How Prussia prepared her revenge, 1806-1813.—**R. Inf.**, February, March, April.

Retreat on Mezieres, 1870.—**R. Cav.**, February.

History of the artillery, France.—**R. Univ.**, March, April.

Service of the military engineers in France during the reign of Louis XIV. —**Genie M.**, February, March, April.

Campaign of 1716; Sweden against Norway.—**N. M. Tids**, 12, 1903.

Worth.—**Armee**, March 13.

History of the 4. Rheinbund regiments, Dukes of Saxony.—**Wochenblatt,** February 21; March 11.

Battle training of the Prussian infantry, 1806.—**Wochenblatt,** March 14; April 16.

Campaign of 1814 in France.—**Wochenblatt,** March 18, 21.

The Thirty Years' War, 1618-1648.—**Exercito,** February, March.

A glance at the South African war.—**R. M. Suisse,** March, April.

Study of the South African war from the cavalry point of view.—**A. Belge,** January-February.

Mortality in South Africa.—**A. and N. Gaz.,** April 4; **U. S. Gaz.,** April 4.

The cavalry in Southern Luzon.—**Jour. U. S. Cav.,** April.

China notes.—**Jour. U. S. Cav.,** April.

The Spanish domination over Algeria and Morocco.—**R. Univ.,** April.

Retreat on Sedan.—**R. Cav.,** March.

Historical examples of sieges from the Franco-German war, 1870-71.—**Proc. R. A. I.,** January.

Plan of the siege of Casale, 1695.—**R. Artig.,** January.

The Canadian war, 1667-69.—**R. Maritt,** February.

Wars in Central Europe.—**Cercle,** March 28; April 4.

Supply service of the international troops in China, 1900-1901.—**Cercle,** April 18, 25.

Capitulation of Santiago.—**A. and N. Jour.,** May 9.

On the history of the war of liberation.—**Wochenblatt,** March 28.

Partisan and guerilla warfare.—**Jour. R. U. S. I.,** March.

Campaigns against India from the west and through Afghanistan.—**Jour. R. U. S. I.,** March.

Events of the Peninsular war.—**R. Mil. Postugal,** April.

Battle of Inkerman and the defense of Sebastopol.—**Sbornik,** 2, 1903.

War of 1854-55 on the coast of Finland.—**Sbornik,** 2, 1903.

War of 1877-1878 in letters and novels.—**Sbornik,** 2, 1903.

Gainesville, 1862.—**U. Serv.,** May.

The naval battle of Manila.—**R. de Mar.,** January.

Operations of the Russian fleet during 1853-54.—**Rundschau,** March.

Prince Bismarck and the German fleet.—**Ueberall,** 27, 1903.

Historical sketch of the Confederate navy.—**U. Serv.,** May.

## MILITARY SCHOOLS.

The Berlin War Academy.—**R. M. Etrang,** February, March.

Proposed changes in instructions for schools for field artillery subalterns.—**Art. Tids.,** 5 and 6, 1902.

French war college; questions for examinations.—**Cercle,** March 21.

The Italian naval academy at Leghorn.—**Ueberall,** 24, 1903.

Military science and technical military schools.—**Jahrbucher,** March.

Military education for young soldiers.—**Proc. R. A. I.,** December 1902; **U. S. Gaz.,** March 28, April 4.

General service and staff college, U. S.—**Jour. U. S. Cav.,** April.

School for candidates for the Engineers, Chili.—**R. de Mar.,** February.

Preparation for war college; written examination in topography.—**Cercle,** April 11.

The military technical high school at Berlin.—**Wochenblatt,** March 4, 7.

The training course for teachers and pupils for the Russian Cadet Corps.—**Wochenblatt,** March 28.

## ORGANIZATION AND ADMINISTRATION.

Reorganization of our field artillery, Belgium.—**Belgique M.**, February 22.

Horse artillery and howitzer batteries.—**Exercito**, February.

Danger of small batteries for the reorganization of our field artillery.—**A. Belge**, January-February.

A propos of batteries of 4 guns.—**Belgique M.**, March 22.

Coast defense.—**A. Marine**, March 8.

The defense of our coasts, France.—**Yacht**, March 21.

Notes on coast defense.—**Cercle**, March 7, 14, 21, 28; April 4.

Mobile defense of coast, Italy.—**R. Maritime**, February.

Mobile defenses in 1903, France.—**Yacht**, April 18.

The defense of the coasts of the Baltic states.—**R. Maritime**, March.

Land defense of a coast fortress.—**Proc. R. A. I.**, October-December, 1902.

The complement of sea power.—**Proc. R. A. I.**, October, December, 1902.

Military notes of the great nations.—**Jour. R. U. S. I.**, January.

Remarks upon the Austrian infantry.—**Sbornik**, 2, 1903.

Condition of military surgeons in western Europe.—**Sbornik**, 2, 1903.

Evolution of army reforms.—**U. Serv.**, May.

The executive element in the training and skill of the army surgeon.—**Jour. Mil. Surg.**, April.

Points in the training of hospital corps soldiers.—**Jour. Mil. Surg.**, April.

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## CORRECTIONS.

In the March-April number, 1903 (vol. XIX., No. 2):—

Copyright notice.............................."1903" should be "1902".
Table of Contents, 1st article.........."122" should be "125".
Page 180, 4th paragraph......................"tambour 25" should read "tambour 50".
Page 185, 5th line from bottom........"substracted" should be "subtracted".
Page 187, 5th line from bottom........"read readily" should be "read radially".

In this number, (vol. XIX. No. 3):—

Page 265, 1st Paragraph, 2nd line.........."involing" should be "involving".

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and RECREATION

Merchants and Miners Trans. Co.
"QUEEN OF SEA ROUTES"

[illegible]

W. P. TURNER, G. P. A., BALTIMORE, MD.